Quality Assurance Program Plan

Abatement and Selective Demolition
130 Cedar Street
New York, NY 10006

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Revised per EPA Comments

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Plan Approval

The following individuals have reviewed and concur with this Quality Assurance Program Plan (QAPP) for the building located at 130 Cedar Street, New York, NY 10006 (“the Building”) as indicated by their signature.

Mr. David Crawford, Project Director[1]

Ms. Tricia Woods, Quality Assurance Officer[1]

Mr. Mike Campbell, Senior Project Manager[1]

Mr. David Sundell, Site Supervisor[1]

Mr. Matthew Zock, Environmental Investigation Site Safety Manager and Community Air Monitoring Coordinator[1]

Mr. Keith Rickabaugh, Laboratory Program Manager[1]

Ms. Elizabeth Varley, Laboratory Sample Custodian[1]

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[1] Denotes Employee of RJ Lee*Group*, Inc.

1.0 Project Responsibilities

1.1 Project Directors

Project directors have overall responsibility for the design and conduct of this project. They will be the principal data users and decision makers. The project director's duties include:

- Assigning duties to the project staff and familiarizing the staff with the needs and requirements of the project as they relate to the project objectives
- Preparing site-specific schedule
- Reviewing all major project deliverables for completeness
- Closing out the project
- Maintaining the project files

1.2 Project Managers

Responsibility for implementation of the tasks specified in this project plan have been assigned to the project environmental consultants who may personally assess any aspect of this plan and require response actions as needed, or may delegate assessment responsibility to qualified staff. Project Managers have overall responsibility for ensuring successful performance of the tasks specified in this plan.

1.3 Laboratory Project Managers

Each laboratory project manager will report directly to an RJLG project manager or his designee. The laboratory project manager's duties include:

- Ensuring all resources of the laboratory are available as required
- Coordinating laboratory analyses
- Supervising in-house chain-of-custody
- Scheduling sample analyses
- Overseeing data review
- Overseeing preparation of analytical reports
- Overseeing production and final review of analytical reports
- Approving final analytical reports prior to release

1.4 Quality Assurance Officer

The Quality Assurance Officer is responsible for data after it leaves the laboratory.

- Oversee laboratory QA and site QA
- Oversee QA/QC documentation
- Conduct detailed data review or designate a reviewer.
- Determine whether to implement laboratory corrective actions, if required
- Define appropriate laboratory QA procedures

1.5 Laboratory Sample Custodian

A laboratory sample custodian will report to the laboratory manager. Responsibilities of the laboratory sample custodian may include:

- Receiving and inspecting the incoming sample containers
- Recording the condition of the incoming sample containers
- Signing appropriate documents
- Verifying COC (chain of custody)
- Notifying laboratory manager of sample receipt and inspection
- Assigning a unique identification number and customer number to all samples, and entering each in to the sample receiving log
- Initiate transfer of the samples to appropriate laboratory sections

1.6 Laboratory Technical Staff

The laboratory technical staff will be responsible for sample analysis and identification of corrective actions. The staff will report directly to the laboratory managers.

1.7 Site Supervisors

The site supervisors will support the off-site project managers. The supervisor is responsible for leading and coordinating the day-to-day activities of the various resource specialists under his supervision. The supervisor is a highly experienced environmental professional and will report directly to the project manager or his designee. Specific supervisor responsibilities may include:

- Coordinating field related activities with the project manager
- Developing and implementing field related work plans, assurance of schedule compliance, and adherence to the Community Air Monitoring Plan
- Coordinating and managing field staff
- Implementing QC for technical data provided by the field staff including field measurement data
- Adhering to work schedules provided by the project manager
- Coordinating and overseeing the air monitoring program for the site
- Identifying problems at the field level, resolving difficulties in consultation with the RJLG project director, then implementing and documenting corrective action procedures, and provision of communication between team and upper management
- Participating in preparation of the final report

1.8 Field Technical Staff

The field technical staff for this project will be drawn from RJLG's pools of corporate resources. The technical staff will be utilized to gather and analyze data and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

1.9 Analytical Laboratories

Qualified analytical laboratories will be employed to support the project. Tentative laboratory selections are summarized in Table 1. Other laboratories may be contracted, as necessary, to provide additional analytical support as the project progresses for such circumstances as unanticipated analyses.

Only qualified analytical laboratories will be employed to provide support for the project. Criteria for laboratory selection will include, among other things, where applicable:

- Successful participation and accreditation in the New York State Environmental Laboratory Approval Program.
- Accredited participation in the National Environmental Laboratory Accreditation Program.

Table 1. Tentatively Selected Laboratories

Laboratory	Analyte/Analyte Group
RJ Lee Group	Asbestos
	Metals (except mercury)
	Mercury
	Crystalline Silica
	PCMe Fibers
STL Laboratories	Semi-Volatile Organics
	Dioxins/Furans
	Polychlorinated Biphenyls (PCBs)
	Polyaromatic Hydrocarbons (PAHs)

2.0 Data Quality Objectives and Criteria for Measurement

The data quality objectives and criteria for measurement is designed to ensure that sampling and analyses are carefully thought out and that the results of the effort will be adequate to meet the basic objectives of the air monitoring program. Additional indoor or ambient air data generated by site contractors and others may be collected and incorporated into the air monitoring program reports as the data become available or are required.

2.1 Background

The primary issue to be addressed is a potential for emissions from the site in excess of contaminants of potential concern (COPC) air criteria standards in the Specification for Community Air Monitoring to cross the property boundary or emerge from the Building as a result of an engineering or administrative control breakdown.

The secondary issue addressed is to provide a record of air monitoring and any associated responses for future reference.

2.2 Identify the Decision

The decisions to be made on a daily basis are:

- Are engineering controls maintaining air quality at the property boundary within the site standards as set forth in the Specification for Community Air Monitoring?
- If not, what engineering controls or other corrective actions are required?

2.3 Identify Inputs to the Decision

Data needed to achieve the decision objective includes accurate and reliable measurements of real-time and time-weighted analysis for air monitoring and samples collected as provided in the Specification for Community Air Monitoring. During the abatement phase, perimeter air monitoring data of the site may be compared to air results collected inside containment by the Abatement contractor.

The primary data used for decision making will be real-time and laboratory data generated from samples collected at the Site. Additional samples and analysis may occur as required to support decision making.

Inputs to the decision model include established air quality levels for the site contained in the *World Trade Center Indoor Air Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks*, prepared by the Contaminants of Potential Concern (COPC) Committee of the World Trade Center Indoor Air Taskforce Working Group and site background levels. Whichever value is more stringent will be used to determine an exceedance. Established air quality levels are summarized in Table 2. The community action levels are derived assuming a potential one-year exposure to members of the community during the abatement phase and selective demolition phase of the Building. Exposures are assumed for 24-hours per day, 365 days per year. An additional consideration was that air monitoring of ambient air will be conducted at the building perimeter and, therefore, will overestimate actual community exposures. Therefore, application of action levels based on assumed continuous exposure to members of the community to facility perimeter sampling will add an additional inherent “safety factor” to the monitoring program. The following criteria were used for derivation of these action levels.

2.4 Evaluation of Monitoring Results

Target Air Quality Levels

Target Air Quality Levels have been established as internal site management tools. They have been established as thresholds to alert the project team of circumstances that may be a result of project related activity or changes in ambient atmospheric conditions before the airborne constituent concentrations reach level requiring regulatory action. This will allow proactive responses by the project team to identify aberrant conditions/circumstances and address them when necessary.

The Target Air Quality Levels described herein are based on average exposures during the building Abatement Phase and Selective Demolition Phase and are equal to or less than the EPA Site Specific Trigger Levels. Therefore, the following criteria will be used to evaluate the monitoring data collected during pursuant to this program:

- During the first week of sampling, any sample analyte other than $PM_{2.5}$ and PM_{10} in excess of three times the Target Air Quality Level, unless superceded by an EPA Site-Specific Trigger Level, will be considered an exceedance and the actions described below will be taken.
- Following the first week of sampling, a "rolling average" will be established based initially on the first week's results, to which will be added daily values as results are received from the laboratory. A rolling average value for any analyte in excess of the relevant Target Air Quality Level will be considered an exceedance of the Target Air Quality Level and the actions described below will be taken.

Exceedance of an established Target Air Quality Levels for any analyte will result in an evaluation of engineering controls and work techniques in the source area. This evaluation shall include, but not be limited to, the evaluation of work activities that may be causing the exceedance, smoke testing of the critical barriers in question, and inspection, repair of any faulty critical barriers, and corrective action.

EPA Site-Specific Trigger Levels

Any 24-hour value (work shift value on work days or a minimum of a four hour sample value on non-work days in the case of asbestos) in excess of the EPA Site-Specific Trigger Level will be considered an "exceedance". Exceedances of EPA Site-Specific Trigger Levels will result in a stoppage of work associated with the exceedance until an evaluation of emission controls is performed and corrective action is in place. The EPA Site Specific Trigger Levels are applicable to individual sample results. If any of the individual sample results exceed the EPA Site-Specific Trigger Levels, then notification must be made to the USEPA Region 2 office and the NYCDEP. Work will be reinitiated once the USEPA Region 2 office has agreed (and NYCDEP in the case of asbestos exceedances) to the corrective action(s) proposed to prevent the potential for exceedances in future work and such corrective action(s) has been implemented.

Table 2. Target Air Quality Levels and EPA Site Specific Trigger Levels

Analyte	Target Air Quality Levels [1]	EPA Site Specific Trigger Levels [2]
Metals		
Antimony	5 ug/m^3	14 ug/m^3
Barium	5 ug/m^3	5 ug/m^3
Beryllium	0.02 ug/m^3	0.2 ug/m^3
Cadmium	0.04 ug/m^3	2 ug/m^3
Chromium[3]	0.6 ug/m^3	0.6 ug/m^3
Copper	10 ug/m^3	100 ug/m^3
Lead	1.5 ug/m^3	5 ug/m^3
Manganese	0.5 ug/m^3	0.5 ug/m^3
Mercury	0.3 ug/m^3	3 ug/m^3
Nickel	0.2 ug/m^3	28 ug/m^3
Zinc	16 ug/m^3	160 ug/m^3
Particulate and Dust		
Asbestos Structures - AHERA	N/A	70 s/mm^2
Asbestos Fibers (PCMe)	0.0009 f/cc	N/A
Particulate PM-10 (24 hour average)	150 ug/m^3	150 ug/m^3
Particulate PM-2.5 (24 hour average)	40 ug/m^3	65 ug/m^3
Respirable Silica (crystalline)	10 ug/m^3	10 ug/m^3
Semi-volatile Organic Compounds		
Dioxins / Furans (2,3,7,8 – TCDD equivalents)	0.00025 ng/m^3	0.025 ng/m^3
PCBs (total Aroclors)	0.12 μg/m^3	12 μg/m^3
PAHs (benzo-a-pyrene potency factor)	0.034 μg/m^3	3.4 μg/m^3

1. Target air quality level values are applicable to a rolling average concentration after the first week of sampling, except for PM10 and PM2.5.
2. 24-hour values, except for asbestos.
3. EPA Site specific trigger level for chromium is based on a Hexavalent chromium (chrome VI) concentration. The reference value will be compared against total chromium results as a screening for Hexavalent chromium.

2.5 Study Boundaries

The activities which might result in generation of elevated levels of air contaminants are the abatement of asbestos and COPCs from the Building and subsequent selective demolition of the Building. Additionally off-site industrial, construction and demolition activities in the vicinity, as well as atmospheric transport of air contaminants may have a significant impact on community air monitoring samples. The study is limited to the Building and property boundaries.

2.6 Decision Making Rule

Exceedance of the established levels for each analytes maximum background reading will result in an evaluation of engineering controls and work techniques in the source area. The evaluation shall include but not be limited to the evaluation of work activities that may cause an exceedance, smoke testing of the critical barriers in question, inspection and repair of any faulty critical barriers, etc.

The US EPA Region 2 office (any exceedance) and the NYCDEP (asbestos exceedance only) will be notified promptly via phone and electronic mail of any exceedance of either a Target Air Quality Level or an EPA Site-Specific Trigger Level and will be notified promptly of any corrective actions taken in connection with a Target Air Quality Level exceedance or an EPA Site-Specific Trigger Level exceedance.

In the event of an exceedance of an EPA Site-Specific Trigger Level, the owner or its contractor will prepare an exceedance summary report (1-2 pages) stating the nature of the exceedance, causes of the exceedance, and corrective actions taken if the exceedance was determined to be associated with activities on-site. The owner or its contractor will also document (e.g., log book, photographs, meteorological conditions, etc.) nearby off-site activity which could have impacted the project site.

2.7 Limits on Decision Errors

The data collected during this project are not intended to serve as the basis of final risk management decision making at any specific residence or location. Rather, the data serve as a preliminary assessment of potential emissions and are used to trigger evaluation of site engineering controls associated with activity at the Site. These preliminary corrective action judgments are triggered at typical air quality background levels and/or USEPA indicated air criteria. Any value exceeding the trigger level will result in the following actions:

- Halt operations at the site
- Verify analytical data
- Investigate the cause of the exceedance
- Implement corrective action as appropriate
- Collect additional samples to document current conditions
- Report the data to the pertinent on-site personnel and authorities

Every exceedance will be investigated. Using this definition of error, the level of error requiring an investigation is zero (0) or site operations and engineering controls will be investigated.

Exceedances of Target Air Quality Levels, as internal management thresholds, will be handled similarly. Project operations will not, however, be halted to investigate exceedances of Target Air Quality Levels. Any value exceeding the Target Air Quality Levels will result in the following actions:

- Verify analytical data

- Investigate the cause of the exceedance
- Implement corrective action as appropriate
- Collect additional samples to document current conditions
- Report the data to the pertinent on-site personnel and authorities

Every exceedance will be investigated. Using this definition of error, the level of error requiring an investigation is zero (0) or site operations and engineering controls will be investigated

3.0 Measurement and Data Acquisition

3.1 Sampling Process and Design

3.1.1 Observations of Visible Emissions

During each work shift of the abatement phase, the environmental consultants will be tasked with observing the Building's containment barriers and exterior envelope. During each shift, established critical barriers and area(s) of high emission potential will be observed to determine that "no visible emission" is occurring. During the selective demolition phase, the environmental consultant will enforce dust suppression measures to avoid dust from crossing boundaries of the site. The Specification for Community Air Monitoring sets forth the details of this obligation.

3.1.2 Air Monitoring

Analysis and sampling methods used in this Project will follow EPA or National Institute of Occupational Safety and Health (NIOSH) protocols as guidelines or other standard methodologies. Modifications to sampling and analysis protocols listed below may be made as required to permit an accurate and precise analysis. Generally, sampling will be performed once each 24 hour work period, except for asbestos transmission electron microscopy (TEM) samples, which will be taken for the duration of every work shift and once a day during non-work days throughout the duration of the abatement phase. Real-time particulate monitoring will be on a continuous basis. Instantaneous mercury readings will be obtained to evaluate the air quality around the work site at multiple locations each work day. Table 3 sets forth a more detailed explanation of the sample collection and analysis protocols.

Table 3. Community Air Monitoring Sampling Methodologies

Analyte	Method	Sample* Rate (lpm)	Duration Per Sample Period	Comments
		Metals		
Antimony, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury (particulate), Nickel, and Zinc	NIOSH 7300 mod.	2 to 4	24 hours	MCE Filter, ICP-MS Analysis
Elemental Mercury	Ohio Lumex AA, Direct Read	20	Twice per work shift at each monitor site	Elemental (vapor) Mercury Analysis
Mercury (Total)	EPA Method 324 (or equivalent)	0.4	24 hours	Potassium iodide treated charcoal tube
		Particulate and Dust		
Asbestos	NIOSH 7402	2-4	Duration of each shift + one set on non-work days	Analysis via AHERA** mod. methodology
Asbestos PCMe*** fibers	NIOSH 7402 using polycarbonate (PC) filter	1-4	24 hours	SEM/EDS analysis of PC filter
Particulate PM 10	EBAM (Electronic Beta Attenuation Monitor)	16.7	24 hours	Real-time analysis
Particulate PM 10	40 CFR Part 50 Appendix J	1132	24 hours	8"x10" glass fiber filter
Particulate PM 2.5	EBAM (Electronic Beta Attenuation Monitor)	16.7	24 hours	Real-time analysis
Particulate PM 2.5	40 CFR Part 50 Appendix L	16.7	24 hours	47 mm PTFE filter
Crystalline Silica	NIOSH 0600/7500	2.5	24 hours	SKC Aluminum cyclone
		Semi-volatile Organic Compounds		
Dioxins / Furans (PCDDs/PCDFs)	EPA TO-9A	225	24 hours	Quartz fiber and PUF filter
Polychlorinated biphenyls (PCBs)	EPA TO-4A	225	24 hours	Quartz fiber and PUF filter
Polynuclear Aromatic Hydrocarbons (PAHs)	EPA TO-13A	225	24 hours	Quartz fiber and PUF filter

** lpm = liter per minute, sampling rates may be modified to optimize filter sample loading for microscopy and/or gravimetric related analyses.*

*** 40 CFR 763 AHERA TEM analysis protocol*

**** PCMe = phase contrast microscopy equivalent fibers which are greater than 5 micrometers in length and greater than 0.2 micrometers in width as determined by SEM/EDS for comparison to the Target Air Quality Level.*

Asbestos sample collection will be performed in accordance with NIOSH 7402, "Asbestos by TEM". Asbestos analysis will be performed utilizing TEM analysis specified in 40 CFR Part 763, Asbestos Hazard Emergency Response Act, (AHERA), with the following modifications:

- The sensitivity on TEM air samples will be less than 0.002 s/cc.
- Both length and width of all asbestos fibers will be recorded.
- Confirmation by EDS and/or SAED will be performed for each fiber analyzed.
- The morphology of the fibers will be noted and recorded.

Metals sampling and analysis will be performed following NIOSH 7300 "Elements by ICP" methodology with the following modifications:

- ICP-MS will be utilized when analyzing metal air sample filters. Rationale: ICP-MS has an approximate 100X (times) lower detection limit than standard ICP-AES analysis specified in NIOSH 7300.
- Metals to be analyzed by ICP-MS and reported are: Antimony, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury (particulate), Nickel, and Zinc.
- A hot block/acid digestion will be used.

Real-time air monitoring for mercury will be performed utilizing a Lumex RA 915+ direct read instrument. The readings will be entered into the PDA program for inclusion with the daily download of sample collection data.

The Lumex will be utilized to obtain detection levels below established air contaminant criteria. At a minimum, mercury readings will be taken twice per shift at the fixed air monitoring locations once after all shift air samples are initialized and once before the shift samples are collected. At the discretion of the Environmental Consultant and as daily site conditions may dictate, additional mercury readings may be taken.

Airborne dust and particulate at the Building will be monitored using sample collection and real-time air monitoring. Real-time air monitoring for PM-2.5 and PM-10 will be accomplished with direct reading particulate in air monitors. Data from real-time EBAM particulate monitors will be data logged. Samples for asbestos PCMe fibers will be collected in accordance with NIOSH method 7402. Respirable dust and crystalline silica sampling will be performed according to NIOSH Method 0600 protocol with analysis following NIOSH Method 7500 (XRD).

The three semi-volatile organic air samples that are selected to be submitted for analysis each week will be analyzed using the following methods:

- Dioxins and furans by EPA method TO-9A (high resolution gas chromatography with high resolution mass spectroscopy);

- Polychlorinated biphenyls by EPA method TO-4A for common aroclor mixtures (gas chromatography with electron capture detection) and

- Polynuclear aromatic hydrocarbons by EPA method TO-13A (gas chromatography with mass spectrometric detection instrument operated in selected ion monitoring mode).

3.1.3 Air Sampling and Analysis Methods Requirements

Integrated air samples will be collected by drawing air through a method-specified filter, sorbent or other appropriate media at a specified flow rate for a specified period of time. As described in the Specification for Community Air Monitoring, an equivalent or alternative sampling and analysis method may be substituted by the laboratory or project management for methods contained in the Specification for Community Air Monitoring to improve sampling and analysis results.

If alternative methods to those listed in this QAPP or the Specification for Community Air Monitoring are required to achieve the project objectives, these methods will be reviewed by the Community Air Monitoring Coordinator, Laboratory QA Officer and Project Director, and then the USEPA Region 2 will be contacted for review and concurrence. Table 4 in section 3.1.2 summarizes the specific analytical methodologies to be employed.

An example of the expected sample volumes and detection limits is shown in Table 4.

Table 4. Determination of Reporting Limits for Laboratory Analyses Concentrations in Air for Anticipated Volume

Metals Analysis by ICP/MS on 37 mm diameter, 0.8µ pore size MCE Filters

Analyte	Laboratory Reporting Limit	Sample Flow Rate (l/min.)	Sampling Time (min.)	Projected Sample Volume (l)	Reporting Limit Air Concentration
Antimony	0.06 µ/sample	2	1440	2880	0.021 µg/m^3
Barium	0.04 µ/sample	2	1440	2880	0.014 µg/m^3
Beryllium	0.01 µ/sample	2	1440	2880	0.003 µg/m^3
Cadmium	0.01 µ/sample	2	1440	2880	0.003 µg/m^3
Chromium	0.20 µ/sample	2	1440	2880	0.069 µg/m^3
Copper	0.04 µ/sample	2	1440	2880	0.014 µg/m^3
Lead	0.04 µ/sample	2	1440	2880	0.014 µg/m^3
Manganese	0.04 µ/sample	2	1440	2880	0.014 µg/m^3
Mercury (particulate)	0.01 µ/sample	2	1440	2880	0.003 µg/m^3
Nickel	0.04 µ/sample	2	1440	2880	0.014 µg/m^3
Zinc	0.2 µ/sample	2	1440	2880	0.069 µg/m^3

Asbestos TEM (AHERA) and SEM (PCMe Fibers)

Analyte	Analytical Sensitivity	Area of a Field (mm^2)	No. of Fields Analyzed	Projected Sample Volume (l)	Analytical Sensitivity Air Concentration
Asbestos AHERA Structures by TEM (Filter Loading Basis)	1 structure per area analyzed	0.0089	20	N/A	5.6 s/mm^2
Asbestos AHERA Structures by TEM (Volume Concentration Basis)	1 structure per area analyzed	0.0089	20	1200	0.002 f/cc

Respirable Crystalline Silica, 37 mm diameter, 5µ pore size PVC Filters

Analyte	Laboratory Reporting Limit	Sample Flow Rate (l/min.)	Sampling Time (min.)	Projected Sample Volume (l)	Reporting Limit Air Concentration
Respirable Crystalline Silica	0.005 µg/sample	2.5	1440	3600	0.001µg/m^3

Semi-Volatile Organics on PUF/GFF Filters

Analyte	Laboratory Reporting Limit	Sample Flow Rate (l/min.)	Sampling Time (min.)	Projected Sample Volume (l)	Reporting Limit Air Concentration
Dioxins/Furans	65 pg/sample[1]	225	1440	324,000	0.210 pg/m^3
Polynuclear Aromatic Hydrocarbons (PAHs)	12.55 µg/sample	225	1440	324,000	0.039 µg/m^3
Polychlorinated biphenyls (PCBs)	2.625 µg/sample	225	1440	324,000	0.008 µg/m^3

1 – World Health Organization Estimated 2, 3,7,8 – TCDD TEQ Concentration (using ½ EDL)

2 – Estimated Benzo (a) pyrene Potency Factors (EPA) Basis for six compounds (using ½ LOD)

3 – Total PCB Aroclor Concentration for Common Aroclor (using ½ LOD)

3.1.4 Waste Sampling and Analysis Methods Requirements

In the event that waste characterization testing is to be performed to evaluate if an a solid material should be classified as a "Hazardous waste" as per 40 CFR Part 261, representative samples will be obtained and analyzed for suspect analytes (e.g., leachable metals). Examples of the sample collection and testing parameters applicable are listed as follows:

Table 5. Waste Sampling Methodologies

Characteristic	Method	Sample Container	Holding Time
Ignitability	EPA 1010	Glass	ASAP After Collection
Reactivity (sulfide and cyanide)	EPA 4500 Szf (sulfide) EPA 335.4 (cyanide)	Glass	ASAP After Collection
Corrosivity	EPA 9045	Plastic	14 Days
TCLP Volatiles	EPA 8260	Glass	14 Days
TCLP Semi-volatiles	EPA 8270	Glass	14 Days
TCLP Pesticides	EPA 8081	Glass	14 Days
TCLP Herbicides	EPA 8151A	Glass	14 Days
Total PCBs	EPA 8082	Glass	14 Days
TCLP Metals	EPA 6020	Plastic	180 Days (Mercury – 28 Days)

3.1.5 Field QA/QC Samples

Pursuant to the Specification for Community Air Monitoring, QA/QC samples will consist of blanks and paired samples generated by a comparison of various real-time monitoring, time weighted laboratory analysis and previously established background levels. Due to the simultaneous operation of multiple real-time air monitors coupled with multiple and sometimes redundant air samples being collected for laboratory analysis from four close site locations. One duplicate set of samples for asbestos, lead and silica will be obtained at one of the established sampling location each week. The location of duplicate sample collection will be rotated among the established sampling locations. The function of duplicate samples will be served by the comparison of simultaneously collected data. Duplicate samples will not be obtained for semi-volatile organics.

Where modification of standard sampling or laboratory methodology is required, documentation of the modification will be clearly indicated in field notes or other reports as appropriate. Detailed field notes will record information pertinent to each sample collection. Field notes will be available for review following sample collection.

3.2 Sampling, Handling and Custody Requirements

Documentation of sample collection, handling and shipment will include completion of an entry into the field notebook or on an individual field sampling data sheet, completion of chain of custody forms in the field, and entry of data into a field computer. Each sample will be labeled with a unique sample identifier. The project specific methodology for determining and assigning the unique sample identification identifier is as follows:

Sample identification and labeling and the management of field data and information are accomplished with duplicate barcode labels and handheld PDAs with custom designed software. One barcode label is placed on the sample container (e.g., air sample cassette, plastic bag, vial or jar) and the matching label is placed on a field sample data sheet. Pertinent sample information is recorded on the field sample data sheet next to or near the label. The barcode label is then scanned into the PDA and sample information including time, date, location, matrix / collection media, analyte, flow rates (air samples), sample collection duration (air samples), air volume (air samples), surface area (surface samples), temperature and relative humidity is entered into the appropriate fields in the PDA program. There is also a field in the PDA software where the sample collector can enter additional comments based on field observations, environmental conditions, or other information that is potentially valuable for interpretation of the data.

After all of the samples for the work shift have been collected, the PDA is synched with a personal computer and a chain of custody (COC) and data sheets for the samples are printed. The sample collector signs, dates and photocopies these documents. Next, a zip file containing individual data files for each sample is generated. Each data file is an XML file containing all of the sample information that was previously entered into the PDA program. This zip file is then transmitted via e-mail to appropriate personnel who are responsible for receipt, verification and login of the samples at the RJ Lee Group, Inc. Laboratory in Monroeville, Pennsylvania. The zip file and xml files contained therein are used to generate spreadsheets or other data management tools. The samples and original COC are shipped via Federal Express for overnight delivery to the appropriate laboratories.

Specific information to be recorded in the field notebook (or field sampling data sheet) will include, at a minimum the following:

- Date and time of sample collection
- Name of individual collecting sample
- Location sample was collected
- Type (grab, continuous) and size of sample
- Sample preparation techniques employed
- Sample preservation techniques employed
- Manufacturer, model and serial number of any pump, filter, etc. employed in obtaining sample
- Unique sample identifier
- Any other relevant information such as sample site conditions, special handling, etc.

Prior to packaging for shipping, samples will be inspected to ensure that the sample container is appropriately closed and labeled. The shipping container will be inspected and sealed closed.

A chain-of-custody form will accompany every shipment of samples to the analytical laboratory. The purpose of the chain of custody form is to establish the documentation necessary to trace possession from the time of collection to final disposal. Minimally, the chain of custody form will have the following information:

- Project number
- Sampler's signature
- Date and time of sample collection
- Unique sample identifier

A typical chain-of-custody forms for bulk and air samples are shown in Section 17.0.

The shipping forms or a letter of transmittal sent with the samples will describe:

- Number of containers
- Sample preservative (N/A)
- Date and time of sample shipments

The receiving laboratory(s) will enter the following information upon receipt:

- Name of person receiving the sample
- Date of sample receipt
- Sample condition

All corrections to the chain of custody record will be initialed and dated by the person making the corrections. Each chain of custody form will include signatures of the appropriate individuals indicated on the form. The originals will accompany the samples to the laboratory, and copies documenting each custody change will be recorded and kept on file. Chain of custody will be maintained until final disposition of the samples by the laboratory and acceptance of analytical results by the client. One copy of the chain of custody will be kept by field personnel.

All documentation, including sample container labels, chain of custody forms, custody seals and shipping forms will be fully completed in ink (or printed from a computer). Shipping from the site to laboratory will be via overnight delivery.

Upon receipt, samples will be given to the laboratory sample custodian. The sample package will be opened and the contents inspected. Chain of custody forms will be reviewed for completeness. Samples will then be logged and assigned a unique laboratory sample number. Any discrepancies in samples will be noted.

Analytical Methods and Requirements

The most appropriate analytical methods for each environmental medium may depend on the type and level of contamination, interferences as well as the required level of detection. Some modified methods are as follows;

Asbestos sample collection will be performed in accordance with NIOSH 7402, "Asbestos by TEM". Asbestos analysis will be performed utilizing TEM analysis specified in 40 CFR Part 763, Asbestos Hazard Emergency Response Act, (AHERA), with the following modifications:

- The sensitivity on TEM air samples will be less than 0.002 s/cc.
- Both length and width of all asbestos fibers will be recorded.
- Confirmation by EDS and/or SAED will be performed for each fiber analyzed.
- The morphology of the fibers will be noted and recorded.

Metals sampling and analysis will be performed following NIOSH 7300 "Elements by ICP" methodology with the following modifications:

- ICP-MS will be utilized when analyzing metal air sample filters. Rationale: ICP-MS has an approximate 100X (times) lower detection limit than standard ICP-AES analysis specified in NIOSH 7300.
- Metals to be analyzed by ICP-MS and reported are: Antimony, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury (particulate), Nickel, and Zinc.
- A hot block/acid digestion will be used.

3.2.1 Communications

Lines of communication between project personnel and project management staff will be appropriate to enable timely response to events that have the potential to affect public health and quality of data. Project personnel are provided with a project contact list that includes telephone numbers for both routine communications and emergency notifications.

Communications also entail ensuring that information on sample collection, transportation, analysis, and storage; data acquisition, analysis, and reporting personnel assignments and activities, and other information pertinent to the project are distributed to potentially affected personnel in a timely manner.

Changes in procedures, equipment, personnel, or other program elements as a result of an accident or emergency that have the potential to affect data quality or achievement of overall program objectives will be communicated to the Project Managers in writing in a timely manner. Copies of all written communications and written summaries of all substantive telephone conversations will be placed in a permanent project file maintained by the site supervisors.

3.2.2 Custody Procedures

Custody is one of several factors which are necessary to document the history of the samples. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including originals of all laboratory reports and purge files, are maintained under document control in a secure area. A sample is under custody if:

- The item is in actual possession of a person.
- The item is in the view of the person after being in actual possession of the person.
- The item was in actual physical possession and subsequently secured to prevent tampering.
- The item is in a designated and identified secure area.

3.2.3 Field Custody Procedures

Field logbooks and automated data-loggers will provide the means of recording data collection activities performed during the project. Field logbooks will be bound field survey books or notebooks. The project specific identification number should identify each logbook. The title page of each logbook will contain the following:

- Person to whom the logbook is assigned
- Project name
- Project start date and end date

Entries into the logbook will contain a variety of information. For example, each daily entry may include the date, start time, names of team members present, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in permanent ink, signed, and dated. No erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is signed and dated by the sampler. The number of photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the dates or certificates of calibration.

Sampling and air monitoring will follow procedures documented in the Specification for Community Air Monitoring. The equipment used to collect samples will be noted, along with the time of sampling, sample description, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Any duplicate samples will receive an entirely separate sample identification number, and duplication will be noted under the sample description.

3.2.4 Sample Shipping

Shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain of custody intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly shipped. As few people as possible will handle the samples.
- All sample containers will be identified by the use of sample tags with samples number, sampling location, data/time of collection, and type of analysis or a bar code traceable to these parameters.
- Sample labels will be completed for each sample using waterproof ink.
- Samples will be accompanied by a properly completed chain of custody form. The sample numbers will be listed on the chain of custody forms. When transferring the possession of samples, the individuals relinquishing or receiving sign, date and note the time of the exchange. The chain-of-custody documents transfer the custody of samples from the sampler to another person or to/from a secure storage area.
- Shipping containers should be locked and secured with strapping tape and custody seals for shipment to the laboratory.

3.2.5 Laboratory Custody Procedures

When the laboratory receives samples, the sample custodian examines each custody seal to verify they are intact and the integrity of the environmental samples has been maintained. The sample custodian then signs the chain of custody document. The sample custodian examines the contents of the sample shipping container. Sample container breakages or discrepancies between the chain of custody document and sample labels are recorded. All problems or discrepancies noted during this process are to be reported to the laboratory project manager. Inter-laboratory chain of custody procedures and specific procedures for sample handling, storage, disbursement for analysis, and disposal will be followed as per the laboratory's SOPs and/or QA plan.

3.2.6 Final Data Files

The final data file will be the central repository for all documents which constitute evidence relevant to sampling and monitoring activities. RJ Lee Group is the custodian of the data files and maintains all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area. The final evidence file may include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs

- Drawings
- Laboratory data deliverables
- Data review reports
- Data assessment reports
- Progress reports, QA reports, interim project reports
- Custody documentation

3.2.7 Internal Quality Control Checks

QC procedures and checks are used to verify the precision and accuracy of analytical data. Field QC checks are used to identify potential problems associated with sample handling and procedures. Laboratory QC checks are used to identify problems associated with sample preparation and analysis.

3.2.8 Field Quality Control Checks

To check the quality of data from field sampling efforts, blank samples will be collected for analysis.

3.2.9 Laboratory Quality Control Checks

Each laboratory will have a QC program to ensure the reliability and validity of the analysis performed at the laboratory. The internal QC checks differ slightly for each individual procedure but in general the QC requirements may include the following:

- Method and analytical blanks – These blanks are processed using the same reagents and procedures and at the same time as the samples being analyzed. Contamination found in these blanks would indicate that similar contamination found in associated samples may have been introduced in the laboratory and not actually be present in the samples.
- Instrument blanks – These blanks are analyzed at the beginning, intervals during, at the end of an analytical sequence to assess contamination and instrument drift.
- Surrogate spikes – Surrogate spikes are added before sample extractions for organic analyses. Surrogate spikes aid the analyst in determining matrix effects on recovery of compounds in each sample.
- Laboratory duplicates or MS/MSD duplicates – These duplicates are conducted by the laboratory to determine precision and accuracy of the analytical method on various matrices and to demonstrate acceptable compound recovery by the laboratory at the time of sample analysis.
- Laboratory Control Standards (LCS) – LCS samples consist of known amounts of analytes and are prepared and analyzed concurrently with

project samples. The recovery of analytes or compounds in these samples provides a measure of method accuracy in the absence of matrix effects.

- Internal standards are used to ensure that instrument sensitivity and response are stable during each sample analysis.
- GC/MS instrument performance checks – Instrument performance checks are performed to ensure mass resolution, identification, and sensitivity.

All data obtained will be properly recorded. The laboratory will reanalyze any samples analyzed in nonconformance with the QC criteria, if sufficient volume is available.

4.0 Instrument Calibration and Frequency

Laboratory methods and any corresponding SOPs identify the minimum requirements to be met by the laboratory performing the analysis, to meet adequate instrument calibration frequency, and QA/QC for raw data and reports.

4.1 Field Instrument Calibration

Field sampling and monitoring equipment fall into three categories: those calibrated prior to each use, those calibrated at the factory and those calibrated on a scheduled periodic basis. Frequency of calibration will be based on the type of equipment and manufacturer's recommendations, values given in national standards, the intended use and experience.

Equipment will be calibrated using reference standards (e.g., NIST) or other industry accepted standards. If national standards do not exist, the basis for calibration will be documented. Field equipment calibration will be performed as described by the equipment manufacturer. Calibrated equipment will be uniquely identified by using the manufacturer's serial number or other means.

Scheduled periodic calibration of testing equipment will not relieve field personnel of the responsibility to verify that equipment is functioning properly. If an individual suspects an equipment malfunction they will remove the device from service, tag it so that it is not used, and notify the site supervisor so that recalibration can be performed or a substitute obtained. Instruments in use that are past due for calibration will be immediately calibrated.

Table 6. Field Instrument Calibration and Zero Check

Device	Calibrator	Frequency
Personal Pumps	Bubble meter, dry cal or rotometer	Before each use
Hi-volume Personal Pumps	Bubble meter, dry cal or rotometer	Before each use
BAM or TEOM	Factory supplied calibrator	Annual factory calibration. Initial calibration at the start of monitoring, then quarterly calibration checks.

4.2 Laboratory Instrument Calibration

Calibration procedures for specific laboratory instruments vary and may consist of initial calibrations (3 or 5 points), initial calibration verifications and continuing calibration verifications depending on the instrument. SOPs are established within the laboratory for all analytical and administrative procedures. The SOP for each analysis performed in the laboratory describes the calibration procedures, frequency, acceptance criteria and the conditions that will require recalibration.

The laboratory maintains a sample log for each instrument which will contain the following information: instrument identification, serial number, date of analysis, analyst, calibration data and the samples associated with specific calibrations.

4.3 Calibration Failures

Equipment that fails calibration or becomes inoperable during use will be removed from service, tagged to indicate that it is out of calibration, and segregated to prevent inadvertent use. Such equipment will be repaired and recalibrated or replaced as appropriate.

Results of activities performed using equipment that has failed recalibration will be evaluated by the laboratory manager. If the activity results are adversely affected, the results of the evaluation will be documented and the appropriate personnel notified.

Records will be prepared and maintained for each calibrated measuring and testing instrument and for each reference standard to demonstrate that calibration procedures are traceable. Calibration records will include as appropriate:

- Type and identification number of equipment
- Calibration frequency and acceptable tolerances
- Identification of calibration procedure used;
- Calibration dates
- Identification of individual(s) and/or organizations performing the calibration
- Reference standards used for each calibration
- Calibration data
- Certifications or statements of calibration provided by manufacturers and external agencies, and traceable to national standards
- Information on calibration acceptance or failure.

General calibration requirements include the following:

- All adjustable, mechanical, electronic and/or recording instruments will be calibrated prior to entry into the field
- Instruments that cannot be readily calibrated will be performance checked against a similar instrument (BAM or TEOM) with known performance. If the performance of the instrument varies by more than +/- 10% the data may be subjected to a correction factor.
- Instruments that require frequent calibration checks or calibration during use will be calibrated as specified in their operating manuals.

4.3.1 Maintenance

Each piece of equipment used in activities affecting data quality will be maintained according to specifications provided by the manufacturer. The site supervisor will be responsible for routine maintenance and will have available tools and spare parts to conduct routine maintenance. If the equipment or instrument cannot be maintained to manufacturer's specifications or cannot be properly calibrated, it will be returned to the manufacturer or repair facility for proper maintenance and repair. Once returned from the manufacturer, the instrument will be checked for compliance with project specifications before being used. Logs will be kept detailing maintenance records for field equipment and instrument calibration data.

5.0 Assessment Oversight

5.1 Assessments and Response Actions

The Assessments and Response Actions will be according to the Specification for Community Air Monitoring. The Environmental Consultant’s shift supervisor will oversee and inspect daily sampling activities. If visual observations or instrument readings, verified by multiple instruments, indicate an exceedance of established site air quality standards the shift supervisor will immediately notify a senior project environmental, health and safety officer, evaluate engineering controls and take appropriate corrective action.

The EPA and NYCDEP will be notified in a timely manner of any site air quality standard exceedance and the associated corrective action. Response actions are contained in the Specification for Community Air Monitoring.

6.0 Data Review

Data review and validation will consist of establishing screening criteria, and appropriate statistics for each parameter, describing methods for determining the disposition of suspect data, and documenting final disposition of invalid or qualified data, including outliers. No formal exclusion range for data values is established. Monitoring results in excess of Site Trigger Levels will be closely examined and validated by a data review and technical oversight group and acted upon if valid.

Test Statistic: Data will be reviewed and validated in accordance with the requirements of the referenced method. Quantitative professional judgment and sound scientific methodology will be used to determine fiber counts and other analysis results in sampled media. The need for corrective action will be assessed based upon professional judgment supported by instrument and laboratory analysis. Corrective action will be determined by the Environmental Consultant in consultation with, as required, site contractors, project management and regulatory agencies.

Out-of-range data may not be excluded from the validated data set unless the appropriate data value and root cause can be positively established and documented. The data collected during this project are not intended to serve as the basis of final risk management decision-making at any specific residence or location. Rather the data serves as a preliminary assessment of potential emissions that is used as trigger for evaluation of engineering controls associated with site activity.

Suspect data or samples are examined in detail, including any irregularities in its collection and handling. In the absence of any clear indication of invalidity (e.g., equipment failure or operator error), data outliers will remain in the validated data set but will be flagged as outliers per specified criteria (e.g., >3 x standard deviation) from previously established background levels). Valid high data values should include comments in the daily log to indicate activities that may have caused the value. Data points determined to be invalid will be flagged in a clear and consistent manner in the original raw data set and removed from subsequent data summaries and files.

QA for data review will ensure that the screening criteria monitoring is comprehensive, unambiguous, reasonable, and internally consistent; and that data review activities are properly documented. Data discrepancy reports should be prepared describing any data problems observed and any data correction activities undertaken.

Calibration adjustments and adjustments to reduce data to standard conditions for comparability will be clearly documented, and raw data clearly distinguished from "corrected" data (i.e., data to which calibration and standardization adjustments have been applied).

Raw data and adjustments are entered into a computer database, field notes and/or spreadsheet for correction, statistical analysis, formatting, and summarizing to reduce the potential for human error.

7.0 Data Reduction, Review, and Reporting

All data generated through field activities or by the laboratory operation shall be reduced and reviewed prior to reporting. The laboratory shall disseminate no data until it has been subjected to the following procedures.

Data reporting consists of communicating summarized data in a final form. Quality assurance for reporting consists of measures intended to avoid or detect human error and to correct identified errors. Such methods include specification of standard reporting formats and contents of measures to reduce data transcription errors.

Data will undergo peer review by qualified reviewers capable of evaluating reasonableness of the data for the scientific design and data quality.

Reports: A report of all the summary study design characteristics, sample collections and analyses, data quality and results shall be presented by the analytical laboratories.

7.1 Field Data Reduction Procedures

All field data will be written into field logbooks immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. Sampling data and measurements field logs include PDA data and air sampling data sheets.

7.2 Laboratory Data Reduction Procedures

Laboratory data reduction procedures will include the following protocol. All raw analytical data will be logged. Data recorded will include pertinent information, such as the sample identification number and the sample label number. Other details will also be recorded such as the analytical methods used, name of analyst, data of analysis, matrix samples, reagent concentrations, instrument settings, and the raw data. Copies of any strip chart printouts (e.g., gas chromatograms) will be maintained on file. Periodic review of the data logs by the laboratory project manager takes place prior to final data reporting.

For most analyses, data reduction involves the comparison of samples to a standard reference curve. Samples must be analyzed within the concentration range of the calibration curve. For this project, constituents of interest must be analyzed and reported within an appropriate concentration range to report the detected concentrations of all constituents of interest, or reported as not detected at the Target Air Quality Level (TAQL). This may require the laboratory to prepare, analyze, and report the results from more than one dilution. Non-detected values above the TAQL of the analytical method are unacceptable unless due to matrix interference. If a constituent concentration is not detected at the TAQL, the laboratory will compare the raw data to the method detection limit (MDL) or instrument detection limit (IDL).

Results are calculated from the raw data using the formula given in the method. The laboratory project manager, at the conclusion of each operating day, checks all calculations. Errors and corrections are to be noted.

QC data such as laboratory duplicate and surrogates will be compared to the method acceptance criteria. Data considered to be acceptable will be entered into the laboratory computer system. Data summaries will be sent to the laboratory project manager for review. If approved, data are logged into the project database format. Unacceptable data shall be appropriately qualified in the project report. Case narratives may be prepared which should include information concerning data that fell outside acceptance limits and any other anomalous conditions encountered during sample analysis.

7.3 Data Review

Data review will include reviews of all technical holding times, instrument performance check sample results, initial and continuing calibration recoveries, blank results, surrogate spike recoveries, MS recoveries, target compound identification and quantification. In summary, the data evaluation process is a three-tiered process involving the following steps:

- Tier I: The data package is checked for completeness. The sample results are evaluated to assess potential usability issues.
- Tier II: The results of the QC checks, analytical procedures and sample results are assessed and applied to the data set.
- Tier III: The raw data are examined in detail to check for calculation, compound identification, and/or transcription errors.

Completeness checks will be administered on all data to determine whether deliverables specified in the QAPP are present. The reviewer will determine whether all required items are present and request copies of missing deliverables.

7.4 Field Data Reporting

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field and documentation of all field calibration activities.

7.5 Laboratory Data Reporting

Upon analyses completion the laboratory shall issue a report of analyses for each sample. Upon completion of the report, final review will be conducted of the report summaries and case narrative to determine whether the report meets project requirements. In addition to the record of chain of custody, the report format should include of the following:

- Date of issuance
- Laboratory analysis performed
- Any deviation from intended analytical methodology
- Laboratory ID number (if applicable)

- Numbers of samples and respective matrices
- Laboratory report contents
- Project name and number
- Discussion of technical problems or other observations which may impact analytical results including any QC checks which failed
- Signature of laboratory project manager
- Cross referencing of laboratory sample to project sample identification
- Description of any data qualifiers to be used
- Sample preparation and analyses references for samples
- Sample results

7.6 Project Data Reporting

The Project Director will be responsible for communicating/transmitting data from the project team to outside parties including involved regulatory personnel. As described above, exceedances or other out-of-the-ordinary occurrences will be promptly reported to individuals and organizations with project oversight authority. The Project Director will communicate the results of laboratory analyses, data review and evaluation, etc. in the form of formal and informal reports following the conclusion of each stage of the project. Data submittals will be in the form of hardcopy, electronic media or other method as appropriate nature and size of the submittal.

8.0 Performance Audits

Performance and system audits may be conducted during any environmental investigation. These audits may be performed on the laboratory as well as field activities. Audits shall be documented and maintained by the project manager or designee performing the audit.

8.1 Laboratory Performance Audits

Laboratory performance audits may be administered by the Quality Assurance Officer and/or third party laboratory certification agencies on an annual or shorter basis. The Environmental Consultant verifies that annual audits are made by ensuring that the laboratory performing analysis is currently certified by the listed agencies. The audit samples should be used to monitor accuracy and identify and resolve problems in sample preparation and analysis techniques which lead to the generation of nonconforming data. The laboratory performance audits include verification of each analyst's record keeping, proper use and understanding of procedures, and accuracy evaluation. Corrective action will be taken for any performance failure noted.

8.2 Field Performance Audits

A consultant, designee or internal data review group, shall perform field performance audits of the field sample team on a monthly basis at a minimum. If a nonconformance is found in the evaluation of field data, corrective action will be taken to resolve the issue. Corrective actions will be noted in field logs and/or electronic logs.

9.0 Preventive Maintenance

9.1 Field Instrument Preventive Maintenance

Field instruments will be checked and calibrated daily before use. Calibration checks will be documented on the Field Calibration log sheets. Critical spare parts such as tape and batteries will be kept on-site to reduce potential downtime. Backup instruments and equipment will be available on-site or within one-day shipment to avoid delays in the field schedule.

9.2 Laboratory Instrument Preventive Maintenance

Designated laboratory employees regularly perform routine scheduled maintenance and repair of all instruments. All maintenance that is performed is documented in the laboratory's operating record. All laboratory instruments are maintained in accordance with manufacturer's specifications.

10.0 Procedures to Evaluate Data Precision and Accuracy

Data will be reviewed for indications of interferences to results caused by site external sources, sample matrices issues, cross contamination during sampling and transport/storage anomalies.

10.1 Accuracy Assessment

Accuracy will be assessed by determining percentage of response (%R) for surrogate compounds added to a field and/or QC sample to be analyzed. Accuracy for the metals analysis may be further assessed through determination of %Rs for LCSs and MS samples.

Percent recovery for MS/MSD results is determined according to the following equation:

%R = [(Amount in Spiked Sample – Amount in Sample) / Spike amount added] X 100

%R for LCS and surrogate compound results is determined according to the following equation:

%R = [(Experimental Concentration / Spike amount added)] X 100

10.2 Precision Assessment

The relative percent difference (RPD) between the MS and MSD for organics, sample and sample duplicate for inorganics, and field duplicate pair is calculated to compare to precision objectives and plotted. The RPD is calculated according to the following formula.

RPD % = [(Amount in Sample 1 – Amount in Sample 2) / 0.5 (Amount in Sample 1 + Amount in Sample 2)] X 100

10.3 Completeness Assessment

Completeness is the ratio of the number of valid sample results to the total or possible number of samples analyzed. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\textit{Completeness} = \frac{\textit{(number of valid measurements)}}{\textit{(number of measurements planned)}} \times 100$$

The goal for laboratory and field data completeness will be 90% as calculated above.

11.0 Corrective Action

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out of QC performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data review, and data assessment. All corrective action proposed and implemented should be documented in the QA reports to management. Corrective action should only be implemented after approval by a project manager or his designee. If immediate corrective action is required, approvals secured by telephone from the project manager should be documented in an additional memorandum.

For noncompliance problems a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the project manager.

Any nonconformance with the established QC procedures in the QAPP or the Specification for Community Air Monitoring will be identified and corrected in accordance with the QAPP. The project director or his designee will issue a nonconformance report for each of the identified nonconformance conditions.

11.1 Field Corrective Action

Corrective action in the field may be needed when the sample network is changed or sampling procedures and/or field analytical procedures require modification and unexpected conditions. In general the site team may identify the need for corrective action. The site staff in consultation with the Site supervisor will recommend a corrective action. The project manager or designee will approve the corrective measure which will be implemented by the site team. It will be the responsibility of the project manager or designee to ensure the corrective action has been implemented.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved method. The project manager or designee will identify deficiencies. Implementation of corrective actions will be performed by the site team. Corrective action will be documented in QA reports to the entire project team.

Corrective actions will be implemented and documented in the field log. No staff member will initiate corrective action without prior communication of findings through the proper channels.

11.2 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions such as broken sample containers, damaged samples, and potentially high concentration samples may be identified during sample log-in or just prior to analysis. Following consultation with laboratory analysts and section leaders, it may be necessary for the laboratory QA manager to approve the implementation of correction action. The following conditions during or after analysis may automatically trigger corrective action: dilution of samples, additional sample extract cleanup, automatic re-injection/reanalysis when certain QC criteria are not met. The bench chemist will identify the need for corrective action. The laboratory manager in consultation with the staff will approve the required corrective action to be implemented by the laboratory staff. The laboratory QA manager will ensure implementation and documentation of the corrective action. If the nonconformance causes project objectives not to be achieved it will be necessary to inform all levels of project management to concur with the corrective action.

These corrective actions are performed prior to release of the data from the laboratory. The corrective action will be documented in both the laboratory corrective action log. If corrective action does not rectify the situation the laboratory will immediately contact the project manager or his designee.

11.3 Data Review and Data Assessment Corrective Action

The need for corrective action may be identified during data review or data assessment. Potential types of corrective action may include re-sampling by the field team or re-injection/analysis of samples by the laboratory.

If review identifies a corrective action situation it is the project manager who will be responsible for approving the implementation of corrective action, including re-sampling, during data assessment.

12.0 Quality Assurance Reports to Management

12.1 Laboratory Quality Assurance Reports to Management

The laboratory QA plan must require periodic reporting to management on the effectiveness of quality systems, performance of measurement systems and data quality.

12.2 Project Quality Assurance Reports to Management

The RJLG project director or designee may review issues that could adversely affect the achievement of project objections. The review may include but not limited to:

- Laboratory and field data quality
- Laboratory and field audits
- Major problems encountered for each site and the corrective measures taken to prevent recurrence
- Significant recurring problems or trends, which may require global correctable measures
- Recommended or ongoing solutions to issues uncovered during central management review.

13.0 Appendix: Methodologies

Sample analysis conducted using industry standard analytical laboratory methods as follows:

- Asbestos 40 CFR Part 763 (AHERA).
- Metals in accordance with NIOSH 7300MOD method (ICP/MS), using inductively coupled argon plasma (ICP) spectrometry.
- Particle characteristics using scanning electron microscopy (SEM), coupled with energy dispersive spectroscopy (EDS) techniques.
- Silica using X-ray Diffraction (XRD) in accordance with NIOSH 7500 and NIOSH 0600 methods.

14.0 Appendix: Laboratory Certifications

	Asbestos			Chemistry				
	PLM	PCM	TEM	Potable/ Drinking Water	Non-Potable/ Wastewater	Solid/ Hazardous Waste	Lead[3]	Other[4]
AIHA	✓	✓	✓				✓	✓
(NVLAP)	✓		✓					
New York ELAP (NELAC)	✓		✓[1,2]	✓	✓	✓		
Pennsylvania (DEP) (NELAC)				✓	✓	✓		
California ELAP	✓		✓[1,2]	✓	✓	✓		
Connecticut	✓	✓	✓[1,2]	✓				
Louisiana	✓	✓	✓[1]		✓	✓	✓	✓
Maryland				✓				
Montana				✓				
Oregon ELAP			✓[1,2]	✓	✓	✓		
Virginia	✓	✓	✓[2]	✓				
Washington				✓	✓	✓		✓
West Virginia	✓	✓	✓[1]					

[1]TEM Air
[2] TEM Drinking Water
[3]Paint Chips, Wipes, and/or Soils
[4]Metals, Silica, Organic Solvents, Diffusive Samples, Environmental, TCLP, Air and Emissions
[5] Accreditations are based on January 31, 2007 data

Licenses
State of Washington Radioactive Materials License
US Department of Agriculture Quarantined Soil Permit
US Department of the Treasury Alcohol and Tobacco Tax and Trade Bureau – Analysis of Wine for Purposes of Export

15.0 Appendix: Glossary

Quality Control Methods

Quality control methods will include both field and laboratory components. Field personnel may prepare two types of quality control samples: replicates and blanks.

Replicates

For air samples, replicates are defined as separate samples that are collected using separate air pumps and filters. These air samples are collected side-by-side at a location and are sampled for the same amount of time. Air pumps are set at the same air flow rates so that adequate and like air volumes are passed through each filter. Replicate samples will not be collected for any media other than air.

Blanks

Field personal will prepare blank samples for air and dust by labeling unused filter cassettes and submitting them for analysis. The laboratory and its staff will have the responsibility for processing all samples submitted according to the specific protocols for sample custody, analysis, reporting, and associated laboratory QA/QC.

Precision

Precision is a measure of the degree to which two or more measurements are in agreement.

Field Precision

Field precision for real-time particulate monitors is assessed through the collection of co-located samples followed by laboratory analysis and comparison to data of co-located USEPA method reference monitors.

Laboratory Precision

For organic (dioxin) analysis, laboratory analyses shall be assessed through matrix spike (MS) samples.

Sensitivity

Sample matrices and abundant contamination often affect quantification limits of sample analyses. Sample/extract cleanups will be performed, if appropriate, to ensure that quantification limits are met. If the specified quantification limits cannot be achieved, the laboratory QA officer, laboratory project manager, and project manager or designee will assess the usability of the data with regard to the project objectives.

Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

Field Accuracy

Accuracy in the field is assessed through the use of blanks and through adherence to all sample handling, preservations, and holding times.

Laboratory Accuracy

Laboratory accuracy may be assessed through the analysis of method blanks, matrix spike/matrix spike duplicate (MS/MSD and LCS/ICSD) analyses, laboratory control samples (LCSs), surrogate compounds, internal standards, and Performance Evaluation samples (PEs). Laboratory duplicates (for metals) will be analyzed at a minimum frequency of 5% (one in 20) or one sample per batch.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the maximum number expected to be obtained under normal conditions.

Field Completeness

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project.

Laboratory Completeness

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The laboratory completeness goal for this project is 90% for all samples submitted.

Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of population and parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the work plan is followed and that proper sampling techniques are used.

Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, meeting sample holding times, and analyzing and may be assessed using field duplicate samples.

Comparability

Comparability is an expression of the confidence with which one data set can be compared to another.

16.0 Appendix: Program Contact Information

Title	Name	Company	Contact Information
Owner Representative	Christopher Colbourne	Masterworks Development Corporation	56 West 45th Street, 4th Floor New York, NY 10036
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17.0 Appendix: Forms

Figure 1. Typical Chain-of-Custody Form – Bulk Sample

RJLee Group, Inc. **Chain of Custody** Page 1 of 2

350 Hochberg Road · Monroeville, Pa 15146 · 724/325-1776 · FAX 724/733-1799

	Barcode	Sample #	Matrix	Area/Volume	Analysis	Component	Sampled By	Date	Time	Location	Project#
1		5250168	air	0.000,	Metals	Blank	Y Galinski	4/07/2005	11:19		TCN
2		5250975	bulk	N/A	Asbestos	Silver tar paint	D Sundell	4/07/2005	15:25		TCN
3		5250976	bulk	N/A	Asbestos	Silver tar paint	C Mathurin	4/07/2005	15:26		TCN
4		5250977	bulk	N/A	Asbestos	Silver tar paint	D Sundell	4/07/2005	15:29		TCN
5		5250978	bulk	N/A	Asbestos	Tar paper	C Mathurin	4/07/2005	15:32		TCN
6		5250979	bulk	N/A	Asbestos	Tar paper	C Mathurin	4/07/2005	15:33		TCN
7		5250980	bulk	N/A	Asbestos	Tar paper	C Mathurin	4/07/2005	15:33		TCN
8		5251170	air	3621.042,	Silica	air	J Sexton	4/07/2005	14:44		TCN
9		5251171	air	3360.000,	Silica	air	J Sexton	4/07/2005	14:45		TCN
10		5251172	air	5680.067,	Metals	air	J Sexton	4/07/2005	14:48		TCN
11		5251173	air	5250.063,	Metals	air	J Sexton	4/07/2005	14:48		TCN
12		5251174	air	5325.000,	Dust char	air	J Sexton	4/07/2005	14:46		TCN
13		5251175	air	4865.000,	Dust char	air	J Sexton	4/07/2005	14:47		TCN
14		5251176	air	5256.000,	Metals	air	Y Galinski	4/07/2005	14:42		TCN
15		5251177	air	4931.250,	Metals	air	Y Galinski	4/07/2005	14:43		TCN
16		5251178	air	5292.000,	Metals	air	Y Galinski	4/07/2005	14:43		TCN
17		5251179	air	5272.000,	Metals	air	Y Galinski	4/07/2005	14:44		TCN
18		5251180	air	5276.000,	Metals	air	Y Galinski	4/07/2005	14:44		TCN
19		5251181	air	0.000,	Dust char	Blank	Y Galinski	4/07/2005	11:24		TCN
20		5251182	air	5256.000,	Dust char	air	Y Galinski	4/07/2005	14:38		TCN
21		5251183	air	5095.625,	Dust char	air	Y Galinski	4/07/2005	14:39		TCN
22		5251184	air	5292.000,	Dust char	air	Y Galinski	4/07/2005	14:40		TCN
23		5251185	air	4942.500,	Dust char	air	Y Galinski	4/07/2005	14:41		TCN
24		5251186	air	5111.125,	Dust char	air	Y Galinski	4/07/2005	14:41		TCI
25		5251187	air	0.000,	Silica	Blank	Y Galinski	4/07/2005	11:29		TCN
26		5251188	air	3285.000,	Silica	air	Y Galinski	4/07/2005	14:34		TCN
27		5251189	air	3221.750,	Silica	air	Y Galinski	4/07/2005	14:35		TCN
28		5251190	air	3241.350,	Silica	air	Y Galinski	4/07/2005	14:36		TCN
29		5251191	air	3295.000,	Silica	air	Y Galinski	4/07/2005	14:36		TCN

Relinquished by:	Date:	Relinquished by:	Date:
Received by:	Date:	Received by:	Date:

CoC Report v1.2

Figure 2. Typical Field Data Sheet Form

RJLG

Project Number:
Sampled by: ____________________
Date: ____________
Shift: Morning Afternoon Night

RJ Lee Group, Inc. Project Number: - Sample No. 5256059	on: off: Total:	Flow before: after: Avg:	volume:			RJ Lee Group, Inc. Project Number: - Sample No. 5256063	on: off: Total:	Flow before: after: Avg:	volume:			
				°F	%RH						°F	%RH
RJ Lee Group, Inc. Project Number: - Sample No. 5256060	on: off: Total:	Flow before: after: Avg:	volume:			RJ Lee Group, Inc. Project Number: - Sample No. 5256064	on: off: Total:	Flow before: after: Avg:	volume:			
				°F	%RH						°F	%RH
RJ Lee Group, Inc. Project Number: - Sample No. 5256061	on: off: Total:	Flow before: after: Avg:	volume:			RJ Lee Group, Inc. Project Number: - Sample No. 5256065	on: off: Total:	Flow before: after: Avg:	volume:			
				°F	%RH						°F	%RH
RJ Lee Group, Inc. Project Number: - Sample No. 5256062	on: off: Total:	Flow before: after: Avg:	volume:			RJ Lee Group, Inc. Project Number: - Sample No. 5256066	on: off: Total:	Flow before: after: Avg:	volume:			
				°F	%RH						°F	%RH

RJ Lee*Group*, Inc. 350 Hochberg Road Monroeville, PA 15146

Figure 3. Typical PDA Form

RJLee Group, Inc. **Sample Details** Page 1 of 17

350 Hochberg Road · Monroeville, Pa 15146 · 724/325-1776 · FAX 724/733-1799

Project #: TCN
Sample #: 5250168

Property		**SubLoc**	NorthEast	**Temp**	70			
Floor	99	**Lat,Long**	,	**Hum**	35			
Grid	Not Acquired	**LocDesc**	Albany Street East					

Sampled	Y Galinski, 11:19, 4/07/2005				**Logged**	Y Galinski, ,	
Component	**Serial/VIN/ID**	**Research ID**	**Sample Type**	**Analysis Type**	**Photo:** No	**Camera ID:** N/A	**Range:** N/A
Blank	N/A	N/A	Field Blank	Metals	**Video:** No	**Cassette ID:** N/A	**Range:** N/A

Matrix Type	**Time On**	**Time Off**	**Flow Rate**	**Observed by 3rd Party**	No
air	04/06/2005 15:19:00	04/06/2005 15:19:00	0.00	**Firm:** N/A	**Rep:** N/A
	Volume	**Filter Size**	**Filter Type**		
	0.000	37mm	MCE		

Comments: Field blank.

Project #: TCN
Sample #: 5250975

Property		**SubLoc**	East	**Temp**	77
Floor	42	**Lat,Long**	,	**Hum**	44
Grid	E	**LocDesc**	N/A		

Sampled	D Sundell, 15:25, 4/07/2005				**Logged**	C Mathurin, ,	
Component	**Serial/VIN/ID**	**Research ID**	**Sample Type**	**Analysis Type**	**Photo:** Yes	**Camera ID:** 040705A	**Range:** 9854/9855
Silver tar paint	N/A	N/A	Grab	Asbestos	**Video:** No	**Cassette ID:** N/A	**Range:** N/A

Matrix Type	**Observed by 3rd Party**	No
bulk	**Firm:** N/A	**Rep:** N/A

Comments: Location 1. To be analyzed by PLM and possibly TEM.

Project #: TCN
Sample #: 5250976

Property		**SubLoc**	East	**Temp**	77
Floor	42	**Lat,Long**	,	**Hum**	44
Grid	E	**LocDesc**	N/A		

Sampled	C Mathurin, 15:26, 4/07/2005				**Logged**	C Mathurin, ,	
Component	**Serial/VIN/ID**	**Research ID**	**Sample Type**	**Analysis Type**	**Photo:** Yes	**Camera ID:** 040705A	**Range:** 9856-9858
Silver tar paint	N/A	N/A	Grab	Asbestos	**Video:** No	**Cassette ID:** N/A	**Range:** N/A

Matrix Type	**Observed by 3rd Party**	No
bulk	**Firm:** N/A	**Rep:** N/A

Comments: Location 2. To be analyzed by PLM and possibly TEM.

Signature: Date: RJLGFieldLoginv0.3 M, Report v1.5

18.0 Appendix: Equipment Calibration Procedures

18.1 Pump Calibration Procedures

The accurate calibration of the sampling pump is essential to the correct calculation of the air volume sampled. It is essential to the air results that pumps are calibrated and read correctly. Sampling pumps should be calibrated before and after each sampling event.

The accuracy of the calibration is dependent upon the type of instrument used as a reference. In the lab, a one-liter burette is used as a soap bubble flow meter, or a wet-test meter is used. (See 18.1.6) The calibration should be of sufficient precision such that the 95% confidence limits on the flow rate are ±5% *(95% of the flow rates will fall in ±5% of the calibrated value)*.

18.1.1 Steps for Calibration with Soap Bubble Flow Meter (Bubble Burette)

The following are steps to be taken when calibrating pumps with a soap bubble flow meter. The sampling train used *(pump, hose, filter, cassette)* in the pump calibration should be the same as the one used in the field.

1. Check the voltage of the pump battery with a voltmeter, both with the pump off and while it is operating, to ensure adequate voltage for calibration. If necessary, charge the battery to manufacturer's specifications.
2. Fill a beaker with10 mil. of soap solution.
3. Connect the filter cassette inlet to the top of the burette with length of hose.

4. Turn the pump on and moisten the inside of the soap bubble meter by immersing the open end of the burette into the soap solution and drawing bubbles up the inside of the burette. Perform this task until the bubbles are able to travel the entire length of the burette without breaking.
5. Adjust the pump rotometer to provide a flow between 1.5 and 2.5 LPM.
6. With a water manometer, check that the pressure drop across the filter is less than thirteen inches of water *(about one inch of mercury)*.
7. Start a soap bubble up the burette and measure the time it takes for the bubble to travel a minimum volume of one liter.
8. Repeat the procedure outlined in number 7 at least three times, average the results, and calculate the calibrated flow rate by dividing the volume traveled by the soap bubble by the elapsed time. If the range between the highest and the lowest of the three flow rates is greater than about 0.33 LPM, then the calibration should be repeated, since it is likely that the precision is not adequate.
9. Data required for the calibration includes: the volume measured, elapsed time, pressure drop, air temperature, atmospheric pressure *(or elevation)*, pump serial number, date, and the name of the person performing the calibration.
10. Corrections to the flow rate for the pumps with rotometers may be necessary if the pressure *(elevation)* or temperature where the samples are collected *(actual flow rate)*, differs significantly from that where the calibration was performed *(indicated flow rate)*. Actual flow rates at time of sampling may be calculated for a linear scale rotometer by using the following correction formula:
    - actual = indicated, where both pressure *(P)* and temperature *(T)* are absolute units, such as:
    - psia= psig + 14.7
    - deg Rakin= deg Fahrenheit + 460
    - deg Kelvin= deg Celsius + 273

18.1.2 Procedure to Calibrate Pumps Utilizing Dry Cal DC-lite (Primary Standard)

1. Connect sampling media to HV/LV pump.
2. Turn on pump and let warm up for a period of 1-2 Minutes.
3. Set up Dry Cal Accordingly, connecting surgical tubing to outlet port of calibration unit. And the inlet port of the sampling media (Cassette). (See 18.1.6)
4. Take the first reading utilizing the Dry Cal. Adjust, as necessary, the pump flow rate until you attain the desired flow rate or sampling methodology to be employed. Once the desired flow rate is attained, take three more readings and take the average of these readings. This is the starting flow rate.
5. Record this starting flow rate.
6. Perform the sampling event.
7. Once the sampling event has been completed, reconnect the pump and media to the dry Cal, take three more readings and average these. This is the ending flow rate.
8. Take starting calibrated averaged value and ending calibrated averaged value, and divide by two, to get averaged start/stop flow rate. This will be the actual flow during the sampling period.

18.1.3 Procedure to Calibrate Rotometers (Secondary Satndard) utilizing a Dry Cal DC-lite (Primary Standard)

1. Connect sampling media to HV/LV pump.
2. Turn on pump and let warm up for a period of 1-2 Minutes.
3. Set up Dry Cal Accordingly, connecting surgical tubing to outlet port of calibration unit and the inlet port of the sampling media (Cassette). (See 18.1.6)
4. Connect the rotometer to the end of the media and the pump
    a. LV pumps are calibrated from .5 LPM to 3.0 LPM in 0.5lpm increments
    b. HV pumps are calibrated from 5.0 LPM to 12.0 LPM by 1.0 LPM increments
5. To find readings, examine the rotometer while the pump and media are connected to the rotometer, the middle of the ball is where you reading values will be determined by. Examine the reading of the rotometer at marking increments to find the value at which you are currently running at in LPM.
6. Evaluate three times at each set values in LPM alternating between the rotometer and the Dry Cal to the appropriate reading for each rotometer as mentioned in step 4. (See 18.1.6)
7. These numbers that have been recorded for each of the appropriate value for the appropriate rotometers are the installed into an output regression computer program, whereby the actual flow rates are calculated and graphed according to the flow rates for each of the appropriate values in a chart.
8. At the bottom of the cart is the actual reading of the rotometer and to the left hand side is the computerized actual flow rate of the rotometer value .Any rotometers that fall outside range of 5% Standard Deviation are calibrated monthly, and those which are within are calibrated every 3 months.

18.1.4 Secondary Calibration of Low Flow Pumps

In the field, low volume pumps are calibrated by using a rotometer with accompanying raw data and flow chart for each rotometer calibrated by a Dry Cal DC-lite and utilizing a computer program. The computerized values are the actual reading of the rotometer and the corrected computerized corrected values for the flow rates. The Low flow rotometer is designed with graduations indicating 0.5 to 5 liters per minute intervals

When calibrating a low flow pump, attach the rotometer to the pump hose using a calibration pump or media. (See 18.1.6). Turn the pump on, allowing the pump to "warm up" and read the value indicated by the middle of the ball in the rotometer. (Disregard the meter on the pump.) This reading is called the "Roto Value", and should be noted in the appropriate column on the Calibration of Sampling Pumps Sheet. (See 18.1.6) By reading the bottom of the Graph Sheet,(these are the Rotometers values, and on the left is the corrected flow rates for these values.) follow upwards from the flow rate and then where it crosses the line on the slope follow that to the left to find the corrected flow value for your reading. This will be the actual flow rate of your pump. This flow rate will be needed later when completing the Air Sample Data Sheet. The actual flow rate of your pump and the corrected flow rate will be needed for your Calibration Sheet.

The Low flow pumps are to be calibrated before they are placed out into the field and at the end of the day when they are taken out of service. The average of two flow rates is to be placed on the Air Sample Data Sheet(s). (See 18.1.6)

18.1.5 Secondary Calibration of High Flow Pumps

In the field, High volume pumps are calibrated by using a rotometer with accompanying raw data and flow chart for each rotometer calibrated by a Dry Cal DC-lite and utilizing a computer program. The computerized values are the actual reading of the rotometer and the corrected computerized corrected values for the flow rates. The High flow rotometer is designed with graduations indicating 5.0 to 20.0 liters per minute intervals. Never use a low flow rotometer when calibrating High flow pumps and visa versa.

When calibrating a High flow pump, attach the rotometer to the media using a calibration media. (See 18.1.6). Plug the high flow pump into an electrical socket, and attach the rotometer to the media using a calibration cassette. Read the value indicated by the middle of the steel ball in the rotometer. Note the pump number and value of the rotometer. Set the value desired by turning the knob on the High flow pump. Once the desired value is set, lock the valve and unplug the high flow. This shuts off power, enabling the technician to place the test cassette to the end of the plastic tubing, and to position the sample for area of placement of sample location. This desired reading is called the “Roto Value”, and should be noted in the appropriate column on the Calibration of Sampling Pumps Sheet. (See 18.1.6) By reading the bottom of the Graph Sheet, (these are the Rotometers values, and on the left is the corrected flow rates for these values.) follow upwards from the flow rate and then where it crosses the line on the slope follow that to the left to find the corrected flow value for your reading. This will be the actual flow rate of your pump. This flow rate will be needed later when completing the Air Sample Data Sheet. The actual flow rate of your pump and the corrected flow rate will be needed for your Calibration Sheet.

The High flow pumps are to be calibrated before they are placed out into the field and at the end of the day when they are taken out of service. The average of two flow rates is to be placed on the Air Sample Data Sheet(s). (See 18.1.6)

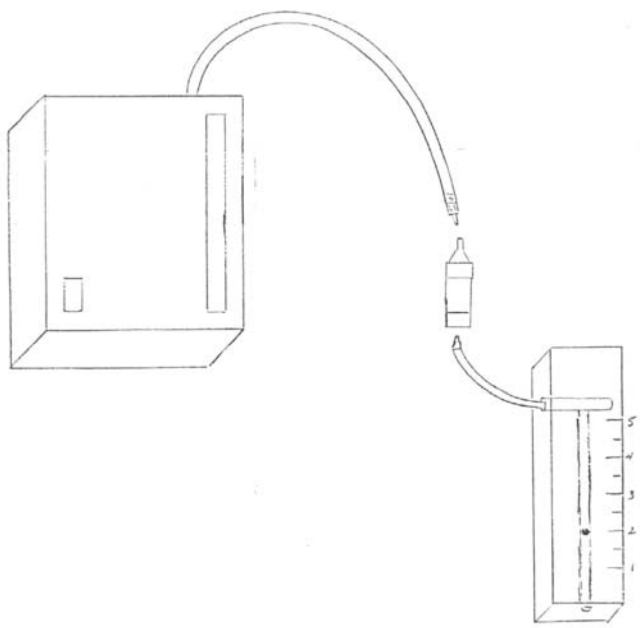
18.1.6 Diagrams

Calibration of Sampling Pumps

		Date: 00-00-00
Client:	PIN: 0000000	Client Code: BLA
Project Location: 1st Floor Room 222		Technician: JD

Times	Pump Serial Number	Roto Number	Roto Value	Graph Correction Flow Rate	Average
Begin	L-8461	LV-09	1.5	1.7	1.6
End			1.2	1.5	
Begin	L-9065	LV-09	2.0	2.2	2.2
End			2.0	2.2	
Begin	L-3452	LV-09	1.0	1.2	1.3
End			1.2	1.4	
Begin	H-0192	HV-17	11.0	12.0	12.0
End			11.0	12.0	
Begin	H-0195	HV-17	11.0	12.0	11.7
End			10.5	11.5	
Begin	H-0193	HV-17	11.0	12.0	12.0
End			11.0	12.0	
Begin					
End					
Begin					
End					
Begin					
End					
Begin					
End					
Begin					
End					
Begin					
End					

PLACEMENT OF ROTOMETER TO LOW-FLOW PUMP



PLACEMENT OF ROTOMETER TO LOW-FLOW PUMP

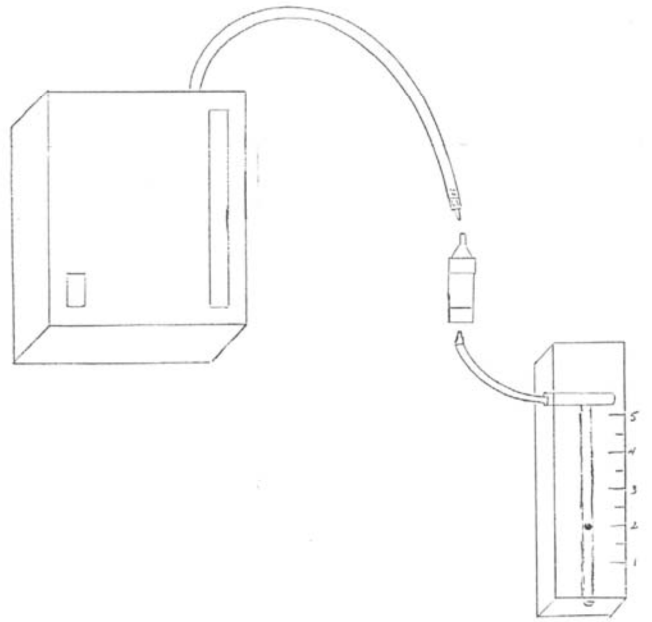
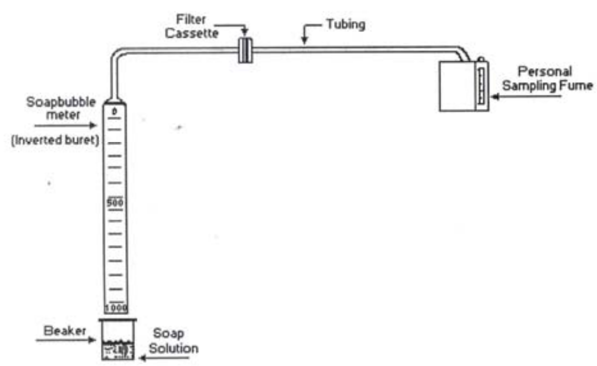
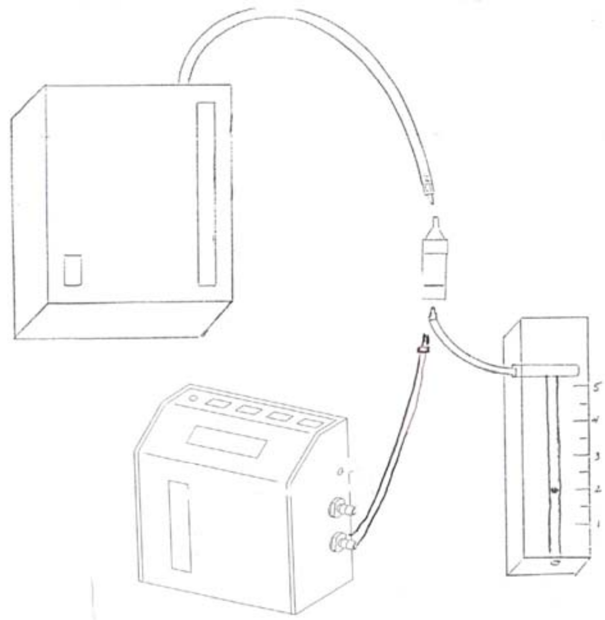


FIGURE II:1-12. CALIBRATION SET-UP FOR PERSONAL SAMPLING WITH FILTER CASSETTE.



CALIBRATION OF ROTOMETER TO LOW FLOW PUMP + ELECTRONIC BUBBLE METER



18.2 Calibration of TE-6070V High Volume sampler for PM10

GENERAL CALIBRATION REQUIREMENTS

PM10 High Volume Air Samplers should be calibrated:

1. Upon installation

2. After any motor maintenance

3. Once every quarter (three months)

4. After 360 sampling hours

"Note" for supplemental guidance reference EPA's Quality Assurance Handbook Section 2.11 also Appendix J located at end of this manual.

CALIBRATION KITS

The two types of calibration kits available for PM10 High Volume Air Samplers are the TE-5025 and the TE-5028.

The TE-5025 utilizes five resistance plates to simulate various filter loading conditions. The TE-5025 calibration kit includes: carrying case, 30" slack tube water manometer, adapter plate, 3' piece of tubing, TE-5025A orifice with flow calibration certificate, and 5 load plates (5,7,10,13,18).

The TE-5028 is the preferred method to calibrate PM10 High Volume Air Samplers. It simulates change in the resistance by merely rotating the knob on the top of the calibrator. The infinite resolution lets the technician select the desired flow resistance. The TE-5028 calibration kit includes: carrying case, 30" slack tube water manometer, adapter plate, 3' piece of tubing, and TE-5028A orifice with flow calibration certificate.

Each TE-5025A and TE-5028A is individually calibrated on a primary standard positive displacement device, which is directly traceable to NIST.

** It is recommended by USEPA that each calibrator should be re-calibrated annually for accuracy and reliability.

CALIBRATION PROCEDURE for TE-6070V, TE-6070DV, TE-6070V-BL, TE-6070DV-BL

The following is a step by step process of the calibration of a **TE-6070V, TE-6070DV, TE-6070V-BL, TE-6070DV-BL Volumetric Flow Controlled PM10 Particulate Sampling System.** Following these steps are example calculations determining the calibration flow rates for the sampler. The flow rate of the sampling system is controlled by a Volumetric Flow Controller (VFC) or dimensional venturi device. This calibration differs from that of a mass flow controlled PM10 sampler in that a slope and intercept does not have to be calculated to determine air flows. The flows are converted from actual to standard conditions when the particulate concentrations are calculated. With a **V**olumetric **F**low **C**ontrolled (VFC) sampler, the calibration flow rates are provided in a **Flow Look Up Table** that accompanies each sampler. The attached example calibration worksheet uses a TE-5028A **Variable Orifice Calibrator** that uses an adjustable or variable orifice, which we recommend when calibrating a **VFC**.

Proceed with the following steps to begin the calibration.

Step one: Mount the calibrator orifice and top loading adapter plate to the sampler. A sampling filter is generally not used during this procedure. Tighten the top loading adapter hold down nuts securely for this procedure to assure that no air leaks are present.

Step two: Turn on the sampler and allow it to warm up to its normal operating temperature.

Step three: Conduct a leak test by covering the holes on top of the orifice and pressure tap on the orifice with your hands. Listen for a high-pitched squealing sound made by escaping air. If this sound is heard, a leak is present and the top loading adapter hold-down nuts need to be re-tightened.

"WARNING" Avoid running the sampler for longer than 30 seconds at a time with the orifice blocked. This will reduce the chance of the motor overheating.

"WARNING" never try this leak test procedure with a manometer connected to the side tap on the calibration orifice or the blower motor. Liquid from the manometer could be drawn into the system and cause motor damage.

Step four: Connect one side of a water manometer or other type of flow measurement device to the pressure tap on the side of the orifice with a rubber vacuum tube. Leave the opposite side of the manometer open to the atmosphere

Step five: Connect a water manometer to the quick disconnect located on the side of the aluminum outdoor shelter (this quick disconnect is connected to the pressure tap on the side of the filter

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b = intercept of *Q actual* orifice calibration relationship.

Once these actual flow rates have been determined for each of the five run points, they are recorded in the column titled Qa, and are represented in cubic meters per minute. EPA guidelines state that at least three of these calibrator flow rates should be between 1.02 to 1.24 m^3/min (36 to 44 CFM). This is the acceptable operating flow rate range of the sampler. If this condition is not met, the sampler should be recalibrated. An air leak in the calibration system may be the source of this problem. In some cases, a filter may have to be in place during the calibration to meet this condition.

The sampler H_2O readings need to be converted to mm Hg and recorded in the column titled Pf. This is done using the following equation:

$$\mathbf{Pf = 25.4\ (in.\ H_2O/13.6)}$$

where: Pf is recorded in mm Hg
in. H_2O = sampler side pressure reading during calibration.

Po/Pa is calculated next. This is used to locate the sampler calibration air flows found in the Look Up Table. This is done using the following equation:

$$\mathbf{Po/Pa = 1 - Pf/Pa}$$

where: Pa = ambient barometric pressure during calibration, mm Hg.

Using Po/Pa and the ambient temperature during the calibration, consult the Look Up Table to find the actual flow rate. Record these flows in the column titled Look Up.

Calculate the percent difference between the calibrator flow rates and the sampler flow rates using the following equation:

$$\mathbf{\%\ Diff. = (Look\ Up\ Flow - Qa)/Qa * 100}$$

where: Look Up Flow = Flow found in Look Up Table, m^3/min
Qa = orifice flow during calibration, m^3/min.

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The EPA guidelines state that the percent difference should be within + or - 3 or 4%. If they are greater than this a leak may have been present during calibration and the sampler should be recalibrated.

Operational Flow Rate

Operational Flow Rate is the flow rate at which the VFC sampler is actually operating at. The line on the worksheet labeled Operational Flow Rate is where the side tap reading is recorded which is taken with only a clean filter in place. With this side tap reading, Pf and Po/Pa are calculated with the same equations listed above. This reading should be between 1.02 to 1.24 m^3/min (36 to 44 CFM), the acceptable operating range.

This completes the calibration of this sampler.

Example Problems

The following example problems use data from the attached VFC sampler calibration worksheet. After all the sampling site information, calibrator information, and meteorological information have been recorded on the worksheet, actual air flows need to be determined from the orifice manometer readings taken during the calibration using the following equation:

1. **Qa = 1/m[Sqrt((H_2O)(Ta/Pa))-b]** Where:
2. Qa = actual flow rate as indicated by the calibrator orifice, m^3/min
3. " H_2O = orifice manometer reading during calibration, in. "H_2O
4. Ta = ambient temperature during calibration, K (K = 273 + °C)
5. Pa = ambient barometric pressure during calibration, mm Hg
6. m = slope of *Q actual* orifice calibration relationship
7. b = intercept of *Q actual* orifice calibration relationship.

Note that the ambient temperature is needed in degrees Kelvin to satisfy the Qa equation. Also, the barometric pressure needs to be reported in millimeters of mercury (if sea level barometric pressure is used it must be corrected to the site elevation). In our case the two following conversions may be needed:

8. **degrees Kelvin = [5/9 (degrees Fahrenheit - 32)] + 273**
9. **millimeters of mercury = 25.4(inches of H_2O/13.6)**

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Inserting the numbers from the calibration worksheet test number one we get:

10. Qa = 1/.99[Sqrt((3.2)(295/747))- (- 0.02866)]

11. Qa = 1.01[Sqrt((3.2)(.3949129)) – (- 0.02866)]

12. Qa = 1.01[Sqrt(1.2637212) – (- 0.02866)]

13. Qa = 1.01[1.1241535 – (- 0.02866)]

14. Qa = 1.01[1.1528135]

15. Qa = 1.164

It is possible that your answers to the above calculations may vary. This is most likely due to different calculators carrying numbers to different decimal points. This should not be an area of concern as generally these variations are slight.

With Qa determined, the sampler H_2O reading needs to be converted to mm Hg using the following equation:

16. **Pf = 25.4 (in. H_2O/13.6)** where:

17. Pf is recorded in mm Hg

18. in. H_2O = sampler side pressure reading during calibration

Inserting the numbers from the worksheet:

19. Pf = 25.4(17.3/13.6)

20. Pf = 25.4(1.2720588)

21. Pf = 32.31 mm Hg

Po/Pa is calculated next. This is done using the following equation:

22. **Po/Pa = 1 - Pf/Pa**

23. where: Pa = ambient barometric pressure during calibration, mm Hg.

Inserting the numbers from the worksheet:

24. Po/Pa = 1 – 32.31/747

25. Po/Pa = 1- .0167989

26. Po/Pa = .957

Use Po/Pa and the ambient temperature during the calibration (Ta) to locate the flow for the calibration point in the Look Up table. Record this in the column titled Look Up. Calculate the percent difference using the following equation:

27. **% Difference = (Look Up flow - Qa)/Qa * 100**

Inserting the numbers from the worksheet:

28. % Difference = (1.193 - 1.164)/1.164 * 100
29. % Difference = (0.029)/1.164 * 100
30. % Difference = (0.024914) * 100
31. % Difference = 2.49

The above calculations have to be performed for all five calibration points.

Operational Flow Rate

Take a side tap reading with only a filter in place.

in. H_2O = 21.75

1. **Pf = 25.4 (in. H_2O/13.6)** where:
2. Pf is recorded in mm Hg
3. in. H_2O = sampler side pressure reading with filter in place
4. Pf = 25.4(21.75/13.6)
5. Pf = 25.4(1.5992647)
6. Pf = 40.62 mm Hg

Po/Pa is calculated next. This is done using the following equation:

7. **Po/Pa = 1 - Pf/Pa**
8. where: Pa = ambient barometric pressure during calibration, mm Hg.

Inserting the numbers from the worksheet:

9. Po/Pa = 1 – 40.62/747
10. Po/Pa = 1- .0543775
11. Po/Pa = .946

Use Po/Pa and the ambient temperature during the calibration (Ta) to locate the flow for the calibration point in the Look Up table.

Po/Pa = .946 Ta = 22 Look up table reading = 1.178 m^3/min

This reading should be between 1.02 to 1.24 m^3/min (36 to 44 CFM), the acceptable operating range. Record this in the column titled Look Up.

Calculate the percent difference using the following equation:

12. **% Difference = (Look Up flow - 1.13)/1.13 * 100**
13. % Difference = (1.178 - 1.13)/1.113 * 100

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14. % Difference = (0.048)/1.13 * 100

15. % Difference = (0.0424778) * 100

16. % Difference = 4.24778

In this case the % Difference has to be + or - 10% of 1.13 or 40 CFM which is 1.02 to 1.24 m^3/min or 36 to 44 CFM, the acceptable operating range.

18.3 E-BAM Zero Span Calibration Checks

Figure 36 Filter RH audit screen.

E-BAM: This is the measurement that the E-BAM is calculating for the selected sensor.

REF: This is the value that the Reference sensor is calculating. By entering the reference value into this entry and pressing CALIBRATE the E-BAM measurement will be calibrated to the entered value.

CALIBRATE: Press this key to recalibrate the E-BAM sensor to the inputted REF value.

DEFAULT: Press this key to restore factory default values.

Filter Temperature
The filter temperature sensor is used to limit the heat added during periods when the sample air has an RH value that exceeds the setpoint see 3.2.2 for more details on the inlet heater. The filter temperature audit screen is located in the in the MAIN MENU / FIELD CALIBRATION / FILTER TEMPERATURE see Figure 37.

```
FILTER TEMPERATURE
 E-BAM:   xx.x C
   REF: -xx.x C
CALIBRATE    DEFAULT
```

Figure 37 Filter Temperature audit screen.

E-BAM: This is the measurement that the E-BAM is calculating for the selected sensor.

REF: This is the value that the Reference sensor is calculating. By entering the reference value into this entry and pressing CALIBRATE the E-BAM measurement will be calibrated to the entered value.

CALIBRATE: Press this key to recalibrate the E-BAM sensor to the inputted REF value.

DEFAULT: Press this key to restore factory default values.

3.3.2 Measuring System Checks – Zero and Span

The measuring system is the heart of the E-BAM. The major components of the E-BAM measuring system are the PMT, the source, and the CPU of the E-BAM. The source is very stable. ^{14}C has a half-life of 5730 years. A beta gauge will operate correctly without source corrections for 10% of the half-life of the source. In theory the E-BAM will operate without need to recalibrate the source for over 500 years. The electronics, CPU and PMT, were selected for their dependability as well as accuracy.

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```
 OPERATE
 LOAD TAPE
 SETUP
 SELF TEST
>FIELD CALIBRATION
 SHUTDOWN/SHIPPING
 VIEW ALARM LOG
 ABOUT
```

From the CALIBRATE MENU select MEMBRANE TEST and press the SELECT key.

```
 TEMPERATURE
 PRESSURE
 FLOW
>MEMBRANE TEST
```

When you are ready to start the calibration press the START key.

```
MEMBRANE TEST
START ZERO TEST

              START
```

The filter tape will advance, the nozzle will lower and the E-BAM will take a four-minute blank ZERO count. Press CANCEL to re-start the test.

```
BLANK ZERO COUNT


CANCEL
```

After the four-minute count the nozzle will move up and wait for you to insert the ZERO membrane.

```
INSERT ZERO MEMBRANE


CANCEL
```

Insert the ZERO Membrane and the nozzle will lower and the E-BAM will take a four-minute ZERO count see Figure 38.

```
CAL ZERO COUNT

CANCEL
```

After the four-minute sample the nozzle will move up and ask you to remove the ZERO membrane.

```
REMOVE MEMBRANE

CANCEL
```

When the ZERO membrane is removed the nozzle will lower and the E-BAM will take a four-minute blank SPAN count.

```
BLANK SPAN COUNT

CANCEL
```

After the four-minute blank SPAN count, the nozzle will move up wait for you to insert the SPAN membrane.

```
INSERT SPAN MEMBRANE

CANCEL
```

After you insert the SPAN membrane the nozzle will lower and the E-BAM will take a four-minute SPAN count see Figure 38.

```
CAL SPAN COUNT

CANCEL
```

Note the test results and take out the SPAN membrane.

```
MEMBRANE TEST RESULT
ZERO MEMBRANE: PASS
SPAN MEMBRANE: PASS
                 OK
```

If the ZERO or SPAN test failed, re-run the test. If the failure continues, clean the detector and re-run the test. If the failure persists, contact the factory service center. Press OK to return to the CALIBRATION MENU.

The measuring system's performance will be verified by completion of the Zero and Span tests.

3.3.2.2 Cleaning

Every year of operation, the accumulated dust on the detector-sensing region should be cleaned off. Refer to Figure 39 for visual instructions.

1. Disconnect all connections from under the E-BAM cabinet.
2. Remove the two 10-32 Phillips head screws from the connector plate under the cabinet.
3. Remove the four 10-32 Phillips head screws from the front panel of the E-BAM. Slide the upper sealing collar upward. There are no threads on the collar and it should move up with a slight twist and firm push.
4. The entire E-BAM assembly can now be lifted slightly and pulled out of the cabinet. Carefully lay the assembly on a clean flat surface with the front panel facing upward.
5. Take out the three 8-32 screws that hold the detector into the lower block and slide the detector out. Do not touch or bump the fragile sensing region on the end of the detector or permanent damage will result.
6. Use a can of office AeroDuster or similar low pressure clean air spray to blow off the dust on the sensitive area. Be sure to hold the nozzle at least two inches away when cleaning. If the dust will not blow off, use a Q-tip dipped in alcohol and rub lightly. When finished cleaning, re-assemble in reverse order.

Note: after each cleaning a Zero and Span must be done to ensure accurate data. See section 3.3.2.1 for instructions on Zero and Span verifications.

To insure accurate measurements the E-BAM is supplied with a zero and span reference plate. This process does not recalibrate the instrument but does a check of the source, PMT and CPU to audit the measuring system. Met One Instruments recommends checking the measuring system with the Zero and Span plates once or twice a year.

3.3.2.1 Calibration Verification

Verification is accomplished using two calibration plates that represent a ZERO and SPAN factory set calibration points. The set of calibration plates are unique to each E-BAM. Always check that the serial number on the calibration plates match the serial number of the E-BAM to be calibrated. The SPAN calibration plate has a fragile membrane covering the hole. Never bump or touch the membrane. Always keep the membranes in their protective plastic case when not in use. When inserting the membranes into the E-BAM, be careful that you do not scrape or rub the filter tape with the metal plate or a calibration error may result. The membrane calibration will take about 16 minutes.

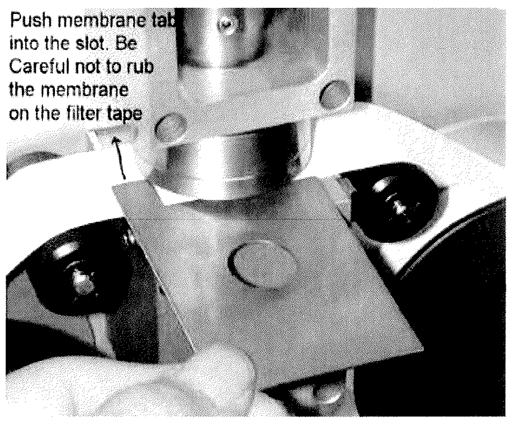

Figure 38 Inserting the Span/Zero plates

Undo the latch and swing open the E-BAM door. To turn on the display, press any key.
Go to the MENU SCREEN and use the up and down arrow keys to select FIELD CALIBRATION then press the SELECT key.

18.4 PQ200 with VSCC (FRM PM2.5) Calibration

3.1.1.2 Verifying flow rate

- Remove the size selective inlet from the top of the downtube, leaving the downtube in place.
- Cap the downtube with the calibration adapter (with the valve OPEN). This adapter should be attached to an automatic bubble meter which is a traceable standard (the Buck and Gillibrator brands are preferable). Devices which have a pulsatile component in their function are not suitable.
- From the Main menu, use the arrow keys until **`* Test Menu`** flashes. Press **SELECT** to enter the Test Menu.
- From the Test menu, press the down arrow until **`* Verify Flow Calibration`** flashes. Press **SELECT**. The **`Check Flow Now!`** screen will be displayed and the sampler will then begin to pump air at the current selected flow rate.
- Use a bubble meter (or other high accuracy calibration device) to monitor the flow rate at the inlet.

  NOTE: When using automatic bubble meters, thermodynamic equilibrium must be considered when taking readings. For the most precise results, take 15 readings and ignore them. Then, take 10 readings and average them. If the flow rate is not within 2 percent of 16.67 Lpm (16.34 to 17.00 Lpm), check for leaks (see Leak Test in Section 3.2), correct, and recalibrate.

  Also, it is recognized that bubble meters are not suitable for use under any but the most temperate of field conditions (10 to 20 degrees C, no direct sunlight). In conditions other than these, a venturi or orifice calibrator is recommended. Inasmuch as these devices rely on a precise and accurate measurement of differential pressure, it is vitally important to ensure that the pressure measuring device is suitable for the climatic conditions.

- When satisfied that the flow rate is as calibrated, press the **ON/OFF** key to exit this function. Press the blank **`(MENU)`** button to return to the Main menu.
- If any offset is observed, make note of the offset, add or subtract it from the previously observed **`Corrected Q`** value and recalibrate the flow rate accordingly.

3.1.1.3 Changing flow rate

- From the Main menu, use the arrow buttons until **`* Set-Ups and Download`** flashes. Press **SELECT** to enter the Setups and Download menu.
- From the Set-Ups menu, use the arrow buttons if necessary until **`* More Selections`** flashes. Press **SELECT**.
- Once again, use the arrow buttons until **`* More Selections`** flashes. Press **SELECT**.
- From the current menu, use the arrow buttons until **`* Set Flow Rate`** flashes. Press **SELECT**. The **`Volume or Mass Control?`** message will be displayed. The current selection will be flashing on the second line.
- Press the desired arrow button for **`(MASS)`** or **`(VOLUME)`**.

- The next screen will display **Target Q: 16.7 LPM** (and the selected calibration method, **Mass** or **Volume**) on the first line. The numeric value will be flashing. (The second and third lines display the current ambient temperature and barometric pressure, and the ambient temperature and barometric pressure for the current calibration.)
- Press **SELECT (NEXT)**. The value preceding the decimal place will stop flashing, indicating it can be edited.
- Use the arrow **(EDIT)** buttons to increase or decrease the selected value. When done press **SELECT (NEXT)**.
- The value following the decimal will then stop flashing. Again use the arrow keys to select a new value. Press **SELECT (NEXT)** to return to the second Set-Ups menu.
- Return to Section 3.1.1.1 to repeat the procedure for additional flowrates.

3.1.2 Temperature Probes

3.1.2.1 Equipment

The following apparatus is required to perform an accurate temperature calibration.

- 4&1/2 digit, precision, calibrated, volt meter (recommend B&K Precision model #2945)
- total immersion, precision, NIST traceable thermometer
- partial immersion, precision, NIST traceable thermometer
- a small slotted screwdriver.

3.1.2.2 Procedure

NOTE: The filter temperature sensor board is located on the front panel and the ambient sensor board is located on a bracket that is attached to the ambient sensor gauge connector. Temperature should be calibrated indoors where temperature variations will be minimal and not abrupt.

- Hang the total immersion thermometer somewhere close to the Gill screen (preferably at about the same height) where it can be read without handling (handling will cause abrupt false readings).
- Set the PQ200 up to run for about 3 or 4 hours to attain equilibration of the sensors and the thermometer.
- When confident that the devices are equilibrated and stable, and while the unit is still running, carefully open the front panel of the PQ200 and locate JP4 on the main P.C. board.
- Set up the DVM (digital volt meter) for a range that will allow a reading of +2.389 VDC.
- Attach the negative (black) lead of the meter to the black wire connection of JP4.
- Touch the positive (red) lead to the test point labeled TP1 on the TEMP SENSOR board to be calibrated. If the voltage reads somewhere between +2.388 and +2.390, the span will not have to be set. A higher or lower reading will have to be adjusted. Use a small slotted screwdriver to adjust the "SPN" trimmer pot on the sensor board.

- Compare the displayed readings to that of the total immersion thermometer. Adjust the

Section 3.0
Calibration, Maintenance and Troubleshooting

3.1 CALIBRATION

3.1.1 Flow

3.1.1.1 Calibration

- From the Main menu, use the arrow keys until **`* Test Menu`** flashes. Press **SELECT** to enter the Test Menu.
- From the Test menu, use the arrow keys until **`* Calibrate Flow`** flashes. Press **SELECT** to enter Flow Calibration mode.
- The **`Volume or Mass Control`** message will be displayed. The current selection will be flashing on the second line. Select **`(MASS)`** or **`(VOLUME)`**.
- The next screen will display **`Target Q: 16.7 LPM`** (and the selected calibration method, **`Mass`** or **`Volume`**) on the first line. The numeric value will be flashing. (The second and third lines display the current ambient temperature and barometric pressure, and the ambient temperature and barometric pressure for the current calibration.)
- Press **SELECT `(NEXT)`**. The value preceding the decimal place will stop flashing, indicating it can be edited.
- Use the arrow buttons to increase or decrease the selected value. When done press **SELECT `(NEXT)`**.
- The value following the decimal will then stop flashing. Use the arrow keys to select a new value. Press **SELECT `(NEXT)`**. The calibration screen will then be displayed.
- Press the **ON/OFF `(PUMP)`** button to turn on the pump. The **`Corrected Q:`** message will then be displayed. (The value for corrected Q that is shown is for reference only.)
- Use the arrow keys to adjust the pump speed to obtain the required flow rate on the calibration device (bubble meter). The arrow keys alone will fine adjust the speed. To coarse adjust, hold the **SELECT** key and the up or down arrow key simultaneously.
- When satisfied that the flow rate is sufficient and stable, press the blank **`(OK)`** button to lock the calibration into memory.

NOTE: Calibrations must be performed at 3 separate flow rate measurements, evenly spaced within the range of +/- 10 percent of the operational flow rate of 16.7 Lpm.

18.5 TE-1000 PUF Determination of Flow Rate

To figure out the total volume of air that flowed through the PUF sampler during your sampling run take a set-up magnehelic gage reading (when you set the sampler up manually turn it on and take a magnehelic gage reading; in our example it should be 60 inches) and a pick-up reading (after the sample has been taken again manually turn sampler on and take a magnehelic gage reading; for our example let's say it read 54 inches). Take 60 + 54 = 114 114/2 = 57 so the magnehelic gage reading you would use is 57 inches. Put that into the formula (on bottom of worksheet):

1/m([Sqrt(magn)(Pav/760)(298/Tav)]- b)

m = sampler slope
b = sampler intercept
magn = average magnehelic gage reading
Tav = daily average temperature
Pav = daily average pressure
Sqrt = square root

Example:

m^3/min = 1/30.278([Sqrt(57)(727/760)(298/295)]-(-.2293))
m^3/min = .033 ([Sqrt(57)(.957)(1.01)] + .2293)
m^3/min = .033 ([Sqrt(55.094)] + .2293)
m^3/min = .033 ([(7.423)] + .2293)
m^3/min = .033 (7.423 + .2293)
m^3/min = .033 (7.652)
m^3/min = .253
lpm = 253

Total liters of air = lpm x 60 x hours that sampler ran

Let's say our sampler ran 23.3 hours
(end ETI reading - start ETI reading)

** Make sure ETI is in hours otherwise convert to hours **

Total liters of air = 253 x 60 x 23.3 = 353,694 liters of air

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